Boggabri Coal Operations Pty Ltd

Biodiversity Management Plan (BMP)

October 2018

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Glossary

Glossary	
ANZCCART	Australian and New Zealand Council for the Care of Animals in Research and Teaching
APVMA	Australian Pesticides and Veterinarian Medicines Authority
ARA	Appropriate regulatory authority
BACI	Before After Control Index
BC Act	*Biodiversity Conservation Act 2016* (NSW) (formerly TSC Act)
BCOPL	Boggabri Coal Operations Pty Limited
BCPL	Boggabri Coal Pty Limited
Benchmark	BBAM benchmarks or appropriate monitoring analogue reference sites
Biodiversity Corridor	500 m vegetated biodiversity corridor between the Project Boundary and the Maules Creek Coal Mine lease.
Biosecurity Act	*Biosecurity Act 2015* (NSW) (formerly (NW Act)
BMP	Biodiversity Management Plan
BNCCA Act	*Brigalow and Nandewar Community Conservation Area Act* 2005 (NSW)
BOAs	Biodiversity Offset Areas
BTM Complex	Collective term for the Boggabri Coal Project, Tarrawonga Coal Project and Maules Creek Project
CCC	Boggabri Coal Community Consultative Committee
CEMP	Construction Environmental Management Plan
CHPP	Coal Handling and Preparation Plant
CMA	Catchment Management Authority
DBH	Diameter at breast height
DoE	Commonwealth Department of the Environment (now DoEE)
DoEE	Commonwealth Department of the Environment and Energy (formerly DoE and SEWPAC)
DP&I	NSW Department of Planning and Infrastructure (now DP&E)
DP&E	NSW Department of Planning and Environment (formerly DP&I)
DPI	NSW Department of Primary Industries
DRG	NSW DP&E – Resources and Geoscience (formerly NSW Trade and Investment - Division of Resources and Energy)
DSE	Dry Sheep Equivalent
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)

Glossary	
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EEC	Endangered Ecological Community
EPL	Environment Protection Licence
FM Act	*Fisheries Management Act* 1994 (NSW)
ha	Hectares
LFA	Landscape Function Analysis
LGA	Local Government Area
LLS	Local Land Services
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
Mtpa	Million Tonnes Per Annum
NIWAC	Northern Inland Weeds Advisory Committee
NSW	New South Wales
NV Act	*Native Vegetation Act* 2003 (NSW) (now repealed)
NW Act	*Noxious Weeds Act* 1993 (NSW) (now repealed)
OEH	NSW Office of Environment and Heritage
Part 3A	Part 3A of *Environmental Planning and Assessment Act* 1979 (NSW)
POEO Act	*Protection of the Environment (Operations) Act* 1997 (NSW)
SDS	Safety Data Sheet
SEWPAC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DoEE)
SWMP	Surface Water Management Plan
RHDV	Rabbit Haemorrhagic Disease Virus
RLP Act	*Rural Lands Protection Act* 1998 (NSW) (now repealed)
RMP	Rehabilitation Management Plan
RM	Remediation Plan
ROM	Run of Mine
TSC Act	*Threatened Species Conservation Act 1995* (NSW) (now repealed)
WIRES	Wildlife Information and Rescue Service
WoNS	Weed of National Significance

1. Introduction

This Biodiversity Management Plan (BMP) has been developed for the Boggabri Coal Project (the Project) on behalf of Boggabri Coal Operations Pty Ltd (BCOPL), a wholly owned subsidiary of BCOPL Australia Resources Pty Limited (80%), Chugoku Electric Power Australia Resources Pty Ltd (10%) and NS Boggabri Pty Limited (10%).

This report addresses Schedule 3, Condition 49 of the Project's state Conditions of Approval PA 09_0182 (Project Approval) which requires Boggabri Coal to prepare and implement a BMP. Under Condition 49 of the Project Approval, the BMP must satisfy a set of requirements including controlling access to biodiversity management areas, bushfire management and translocating and propagating the threatened flora species *Tylophora linearis*. Full details regarding these conditions are provided in Section 4. The *Tylophora linearis* translocation and propagation management plan is provided in Appendix L.

Management measures, performance criteria and procedures contained in this BMP provide a framework for managing biodiversity values within the Project Boundary and Biodiversity Offset Areas (BOAs) throughout the operation of the Project.

This BMP is a working document subject to regular reviews made in consultation with key environmental stakeholders including the Commonwealth Department of the Environment and Energy (DoEE) (formerly Commonwealth Department of the Environment (DoE)), NSW Department of Planning and Environment (DP&E) (formerly NSW Department of Planning and Infrastructure (DP&I)), NSW Office of Environment and Heritage (OEH), NSW DP&E – Resources & Geoscience (DRG) (formerly NSW Trade and Investment - Division of Resources and Energy), NSW Department of Primary Industries (DPI), North West Branch of the Local Land Services (LLS) (formerly Namoi Catchment Management Authority (CMA)) and the Boggabri Coal Community Consultative Committee (CCC).

1.1 Background to the Project

The Project comprises an open cut coal mine located approximately 15 km north-east of the township of Boggabri in north-western NSW. Exploration and development studies commenced in the vicinity of the Boggabri Coal Mine in 1976. Approval for mining operations was initially granted on 22 August 1989 under Part 4 of the *Environmental Planning and Assessment Act* 1979 (NSW) (EP&A Act). Major development of the mine site began in the mid 2000's, with coal mining commencing in 2006 using truck and shovel methods. Infrastructure constructed for the mine before production of coal included:

- 17 km bitumen sealed private coal haul road from the mine to the Boggabri Coal Terminal rail
- loading facility, including bridges over the Namoi River and Kamilaroi Highway
- ROM and product coal stockpiles
- coal crushing plant
- conveyor and truck load out facility

- three km rail loop and turnout
- mine infrastructure area including workshop and offices.

In 2009, the predecessor of BCOPL, Boggabri Coal Pty Ltd (BCPL) lodged a major project application under the now-repealed Part 3A of EP&A Act. This continuation is known as the Boggabri Coal Project and it includes:

- production of up to seven Million tonnes per annum (Mtpa) product coal
- construction of an additional Coal Handling and Preparation Plant (CHPP)
- a 17 km rail spur line and rail load-out facility running from the main line to the CHPP
- upgraded mining fleet, including use of a dragline
- upgrades of other ancillary infrastructure.

The Boggabri Coal Project was approved under the Project Approval, which was awarded on 18 July 2012. Impacts associated with the Boggabri Coal Project were assessed through the Continuation of Boggabri Coal Mine Environmental Assessment December 2010 (Hansen Bailey 2010) (the 2010 EA).

BCPL subsequently applied for modifications of the Project Approval, to modify the Project's Approval boundary for additional activities and ancillary infrastructure. Environmental assessments in accordance with the EP&A Act have been completed for Modification 3, 4 and 5.

The Project and locality are illustrated in Figure 1.1.

The following definitions apply throughout this document:

- **Project Boundary** — the 3,399 ha area adopted to assess biodiversity values directly or indirectly affected by the construction and/or operation of the Project. This includes the active pit and emplacement areas of Coal Lease 368, infrastructure areas occupied by the private haul road, rail spur and power-line easement and the Boggabri Coal Terminal. This area encompasses Boggabri Existing and Boggabri Extension.
- **Boggabri Existing Boundary** — the 1,176 ha area approved for mining under the original Development Consent (DFN 79/1443(z)2). The consent allowed for the mining of up to 5 Million tonnes per annum (Mtpa) product coal for a period of 21 years until 14 November 2011.
- **Modification 2 Boundary** — the 118 ha area adopted to assess biodiversity values directly or indirectly affected by the Modification.
- **Modification 3** — construction of permanent mine access from the Kamilaroi Highway, temporary storage of processed mine over burden material at existing rock quarry and reuse of material for construction of the rail spur embankments and reuse of the Daisymede laydown compound.

- **Modification 4** —adjustment of project boundary, alterations to existing infrastructure, construction of security fence and the use of addition portable fuel storages within operational areas.
- **Modification 5** — Construction and operation of production bores and associated infrastructure on the Heathcliffe, Cooboobindi, Roma, Belleview and Victoria Park properties including 11 kV power lines, above and below ground pipelines and access tracks.
- **Boggabri Extension** — the 658 ha area approved by DP&I for mine expansion on 18 July 2012. In essence, Boggabri Extension comprises the development which is not described in the original project Environmental Impact Statement (EIS) approved in 1987.
- **Biodiversity Offset Areas (BOAs)** — the revised Continuation of Boggabri Coal Biodiversity Offset Strategy (Biodiversity Offset Strategy) (WSP 2017b) incorporates approximately 23 properties within four management zones and ten distinct offset areas:
  - **Eastern Offsets**
    - Sunshine (738.0 ha).
    - Nioka North (857.6 ha).
    - Braefield (1,400.7 ha).
  - **Central Offsets**
    - Mallee BOA (2,066.2 ha).
    - Myall Plains BOA (473.3 ha).
    - Wirrilah BOA (884.2 ha).
    - Goonbri BOA (231 ha).
  - **Namoi Offsets**
    - Namoi BOA (3,214.9 ha).
    - Jerralong BOA (570.1 ha).
  - **Western Offsets**
    - Merriendi BOA (483.2 ha).
- **Regional East-West Wildlife Corridor —** an important environmental corridor that historically linked Leard State Forest with the Nandewar Range, Namoi River and large vegetation remnants to the west. The Biodiversity Offset Strategy (Parsons Brinckerhoff 2010b) aims to recreate habitat linkages within this corridor.

1.2 Revision of the BMP

The Project Approval conditions require that this BMP be revised in accordance with Schedule 3, Condition 50 of the Project Approval. Under this condition the BMP is to be revised in consultation with OEH, DoEE, DPI, the CCC and the North West Branch of the LLS to demonstrate consistency with the findings of the Leard Forest Mining Precinct Regional Biodiversity Strategy (Umwelt 2017) and include implementation plans arising from Conditions 44 and 46.

In addition to the Condition 50 requirements for the BMP to be revised, further revisions have been included to address changes associated with:

- provision of additional biodiversity offsets as part of the revised BOS (Revision F) dated 14 June 2018 (WSP 2017b) under Schedule 3, Condition 43
- additional requirements and conditions resulting from the Project Approval conditions following Modification 2, 3, 4 and 5
- additional requirements concerning the management of a 500 m vegetation corridor (Biodiversity Corridor) between the Project Boundary and the Maules Creek Coal Mine lease boundary as specified under Condition 3 of the DoEE Project Approvals (EPBC 2009/5256)
- to align management actions, monitoring programs and performance and completion criteria to those detailed in the Leard Forest Regional Biodiversity Strategy 2 – Strategy Report (Umwelt (Australia) Pty Limited 2017).

Section 1.3 provides a summary of these additional revision requirements.

1.3 Additional biodiversity offsets

A revision to the original approved BOS (Parsons Brinckerhoff 2010b) was required for the Project to address:

- additional offset areas required under Condition 43 (incorporating the additional 1,000 ha offset including protection of 650 ha of Box Gum Woodland and restoration of 350 ha of Box Gum Woodland DNG) and for understorey clearing outside of Boggabri Existing Boundary
- minor modifications to the project boundary and the relocation of Goonbri Road within the previously identified biodiversity offsets
- changes to the type and extent of vegetation/habitats within identified offsets resulting from the independent verification under Condition 9 of the approval issued for the Boggabri Coal Mine Extension (EPBC 2009/5256) under section 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) (EPBC Act) on 11 February 2013 (EPBC Act Approval).

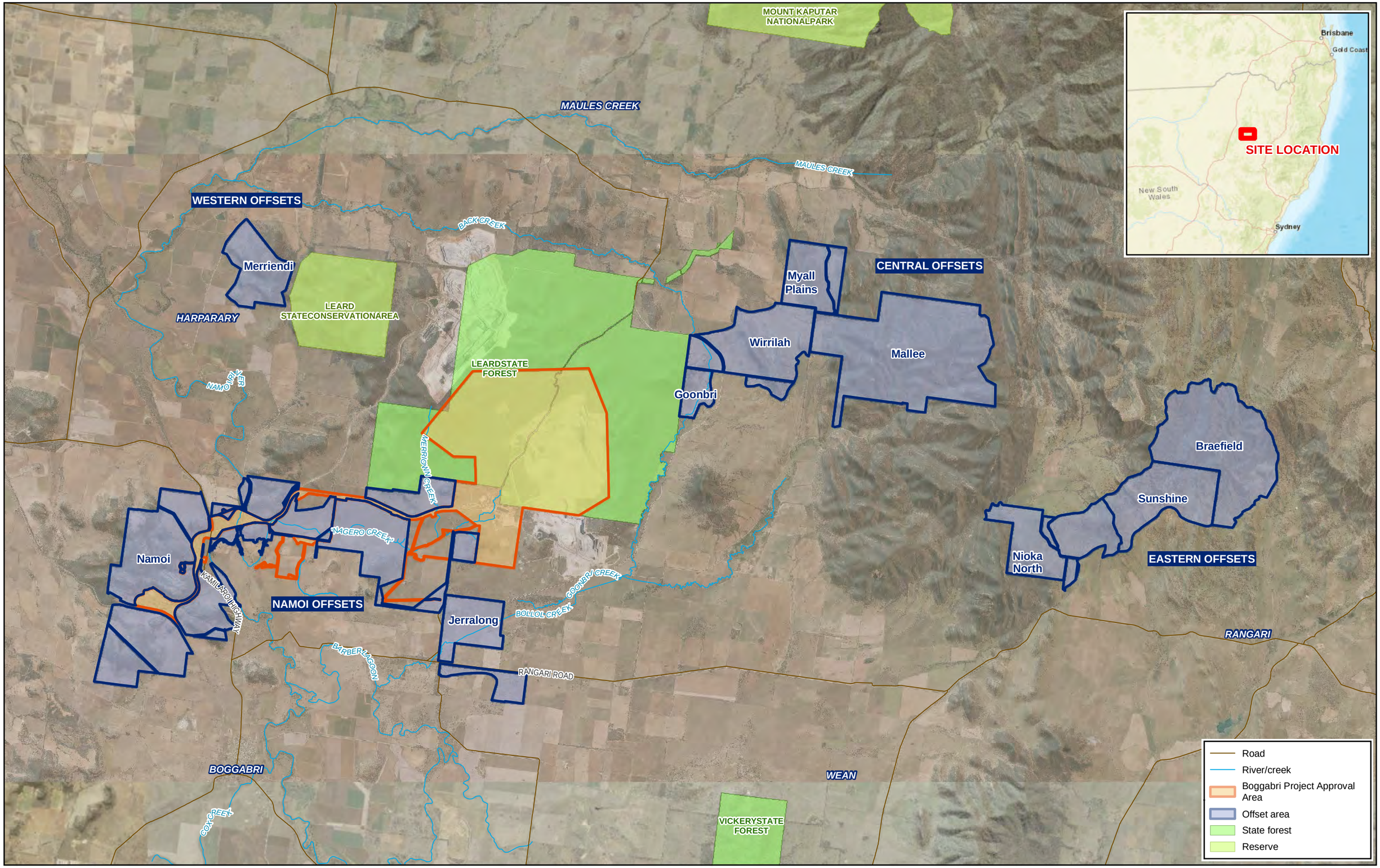
To meet the Project's residual offset requirements under Condition 43, Boggabri Coal have acquired five additional BOAs. Each of the additional BOAs are within the study area of the Leard State Forest Regional Biodiversity Stage (2 – Strategy Report) (Umwelt (Australia) Pty Limited 2017), contribute to the Regional East-West Wildlife Corridor and fulfil the Project

Approvals which require offsetting an additional 1,000 ha of Box Gum Woodland. These additional BOAs are summarised below in Table 1.1.

Table 1.1 Additional BOAs acquired to fulfil biodiversity offset requirements

BOA	BOA area (ha)	Area of remnant Box Gum Woodland to be protected (ha)	Area of Box Gum Woodland DNG to be restored (ha)
Sunshine	738.0	240.5	248.8
Nioka North	857.6	291.5	265.2
Goonbri	231.0	72.3	88.3
Jerralong	570.1	0	0
Braefield	1,400.7	194.3	55.4
Total (ha)	3,797.4	798.6	757.7

A comprehensive description of the values within each of the BOAs are provided in the Appendix E and summarised in Section 6.2.1.



0 1 2 3 kilometres

Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018); Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri

MINE NAME.	2171706A_GIS_BMP018_A1
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	4/09/2018

FIGURE 1.1

TITLE. LOCALITY PLAN

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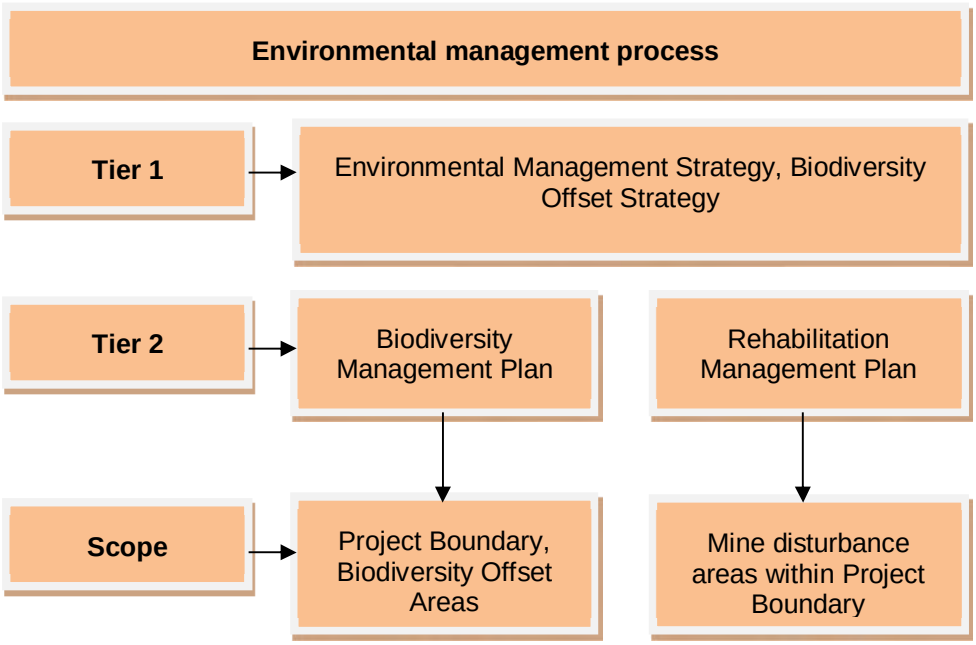
1.4 Plan context

This BMP forms part of Boggabri Coal's environmental management process, which manages environmental issues associated with the Project. The process consists of a Tier 1, Environmental Management Strategy document that details the overall approach to environmental management, and a series of Tier 2 documents, including:

- a Mining Operations Plan (MOP)
- an overarching Construction Environmental Management Plan (CEMP)
- various Environmental Management Plans (EMPs).

Inset 1 summarises the process for managing biodiversity across the Project.



Inset 1 Biodiversity management across the Project

The focus of this BMP is the management of biodiversity resources within the Project Boundary (including the Biodiversity Corridor) and the implementation of the Biodiversity Offset Strategy (WSP 2017b).

Biodiversity values within the Project Boundary are managed though the Monitoring, Inspection and Reporting Program (refer Appendix A) and management of the BOAs is directed by specific management plans provided in Appendix E. Appendix F contains threatened biodiversity implementation sub-management plans, which provide specific measures to manage the Box Gum Grassy Woodland ecological community and threatened species known or predicted to occur within the Project Boundary and/or BOAs. Furthermore, Appendix J contains a Translocation and Propagation Management Plan specifically for managing *Tylophora linearis* within the Project Boundary and BOAs.

The rehabilitation of mine disturbance areas and associated monitoring, reporting and closure requirements will be further directed by a separate Rehabilitation Management Plan (RMP).

The management of biodiversity values within the Biodiversity Corridor is addressed in the Biodiversity Corridor Plan (BCP) (Appendix I). The BCP details the management actions, monitoring requirements and performance and completion criteria for the management of the Biodiversity Corridor.

Management of cultural heritage values within the Project Boundary, which includes the mine rehabilitation area and the salvage of cultural artefacts, is dealt with in the Boggabri Coal Cultural Heritage Management Plan (CHMP) and Strategy. Details of potential conflicts in regards to cultural heritage values for the BOAs is provided in Section 6.2.2.2.

1.4.1 Purpose of this BMP

This BMP provides practical instruction for managing and controlling risks to biodiversity associated with the Project and directs the implementation of the revised Biodiversity Offset Strategy (WSP 2017a). Specifically, this BMP aims to meet the:

- EPBC Act Approval conditions detailed in Table 4-1 of this BMP; and
- Project Approval conditions detailed in Table 4.2 of this BMP.

1.4.2 Consultation

The Boggabri Coal environmental management process and BMP have evolved with the expansion of the Project, with regulatory review and input provided at each key milestone and approval event. Regulatory authorities and other key stakeholders engaged to provide input on biodiversity issues throughout this process include DoEE (formerly DoE), DP&E (formerly DP&I), OEH, DRG (formerly NSW Trade and Investment - Division of Resources and Energy), DPI, North West Branch of the LLS (formerly Namoi CMA), Forests NSW and the CCC.

Preparation of the previous BOMP and BMP required for the approval of Modification 2 was undertaken in consultation with DP&I, OEH, DRG, Forests NSW and Namoi CMA. In order to develop scoping requirements to revise the BMP, BCOPL undertook further consultation with representatives of DoEE, DP&I, Namoi CMA and OEH, as detailed below:

- on 12 July 2012 BCPL engaged DoEE by phone to discuss the scoping requirements of this BMP with regard to the EPBC Act
- on 18 July 2012 BCPL and Parsons Brinckerhoff (now WSP) met with David Kitto from DP&I to discuss the Projects Approval conditions specifically in relation to the BMP and request comments on the BMP and BOMP previously prepared for Modification 2
- on 19 July 2012 BCPL and Parsons Brinckerhoff met with Peter Christie and Rob Taylor from OEH to discuss the requirements of the BMP and request comments on the BMP and BOMP previously prepared for Modification 2.

Initial comments on the BMP for Modification 2 were received from DP&I and OEH on 10 September 2012. These comments were considered in the preparation of the BMP (Rev No. 1).

BCPL undertook further consultation with representatives of the CCC, DoEE, DP&I, Namoi CMA and OEH in the preparation of the BMP (Rev No. 1) as detailed below:

- on 24 September 2012 BCPL and Parsons Brinckerhoff met with Peter Christie from OEH and Steve O'Donoghue from DP&I to discuss regulators comments on the BMP
- on 25 September 2012 BCPL and Parsons Brinckerhoff met with David Kitto from DP&I to discuss further comments provided on the BMP and the potential for an interim staged approval of the document focusing on the management of biodiversity and the operation impacts of mining over the 18 months prior to the completion of the revised regional biodiversity offset strategy
- on 16 October 2012 BCPL presented the BMP to the CCC. This presentation included a detailed questions and answers. Key issues raised included:
    - feral animal control
    - providing community consultation on the integrated land management
    - cumulative effects of mining
    - conflicts between land use changes for conservation offsets and agriculture.

BCPL sent the revised BMP (Rev No. 1) for comment and review to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), DP&I, OEH and the Namoi CMA. Feedback provided by DP&I and OEH was provided on 4 October 2012.

SEWPAC provided the following written correspondence on 14 October 2012:

"As discussed, the department will start reviewing this plan but is unable to provide comments prior to a decision on the Boggabri Coal Project Extension. If the project is approved, the department will assess the Biodiversity Management Plan against any relevant conditions that are attached to that approval".

The Boggabri Coal Project Extension (i.e. the Project) has been approved and now the DoEE will be able to complete the review of the BMP.

Namoi CMA provided comments on the BMP on 2 October 2012 and identified that:

"Namoi CMA has reviewed the Draft BMP and found it to be consistent with the following Namoi CMA's plans and policies:

- *Namoi CMA's CAP 2010-2020*
- *Namoi CMA — Extracted Industries Policy*
- *Namoi CMA — Biodiversity Offset Strategy*

Namoi CMA is satisfied with the management measures and procedures contained in the Draft BMP."

In 2015 BCOPL further consulted with representatives of the CCC, DoE, DP&I, Namoi CMA and OEH in the preparation of preparation of the BOS as detailed below:

- on 21 April 2015 BCOPL and Parsons Brinckerhoff met with Peter Christie from OEH to present the revised BOS properties and implementation plans for threatened biodiversity
- on 23 April 2015 BCOPL and Parsons Brinckerhoff met with Dennis Boschma from the North West Branch of the LLS to present and discuss the additional properties for inclusion in the BOS and implementation plans for threatened species
- on 4 June 2015 BCOPL and Parsons Brinckerhoff met with Steve O'Donoghue from DP&E and OEH to inspect the recent biodiversity offset acquisitions
- detailed ecological reports on the biodiversity offset properties were also provided to DP&E in June 2015
- on 26 October 2015 BCOPL and Parsons Brinckerhoff met with DP&E to further discuss the submitted BOS and implementation plans for threatened biodiversity
- on 19 November 2015 a summary of the key changes were presented to CCC members during the meeting.

In 2017 BCOPL further consulted with representatives OEH, DP&E and DoEE regarding the revised BOS and BMP as detailed below:

- on 1 June 2017 BCOPL and WSP met with Steve Cox, Renee Shepherd from OEH and Steve O'Donoghue form DP&E to discuss finalising the revised BOS and updates to the BMP
- on 13 June 2017 BCOPL and WSP met with representatives from the DoEE regarding finalising the revised BOS and updates to the BMP
- on 7 December 2017 Idemitsu submitted a revised version of the BMP to OEH seeking comment and review
- on 13 April 2018 BCOPL received from OEH detailed review comments on the submitted BMP.

Additional recommendations were also made on the BMP in the Independent Biodiversity Audit (IBA) by Umwelt Pty Ltd on 15 May 2018.

1.5 Contact details

The names and contact details of key Project personnel are provided in Table 1.2.

Table 1.2 Site contacts

Title	Company	Contact No
General Manager Operations	Boggabri Coal Operations Pty Ltd	02 6743 4775
Environment Superintendent	Boggabri Coal Operations Pty Ltd	02 6743 4775
Mine Manager	Boggabri Coal Operations Pty Ltd	02 6749 6006

The names and contact details of key personnel associated with fauna welfare are provided in Table 1.3.

Table 1.3 Site local veterinary clinics and animal welfare organisations contacts

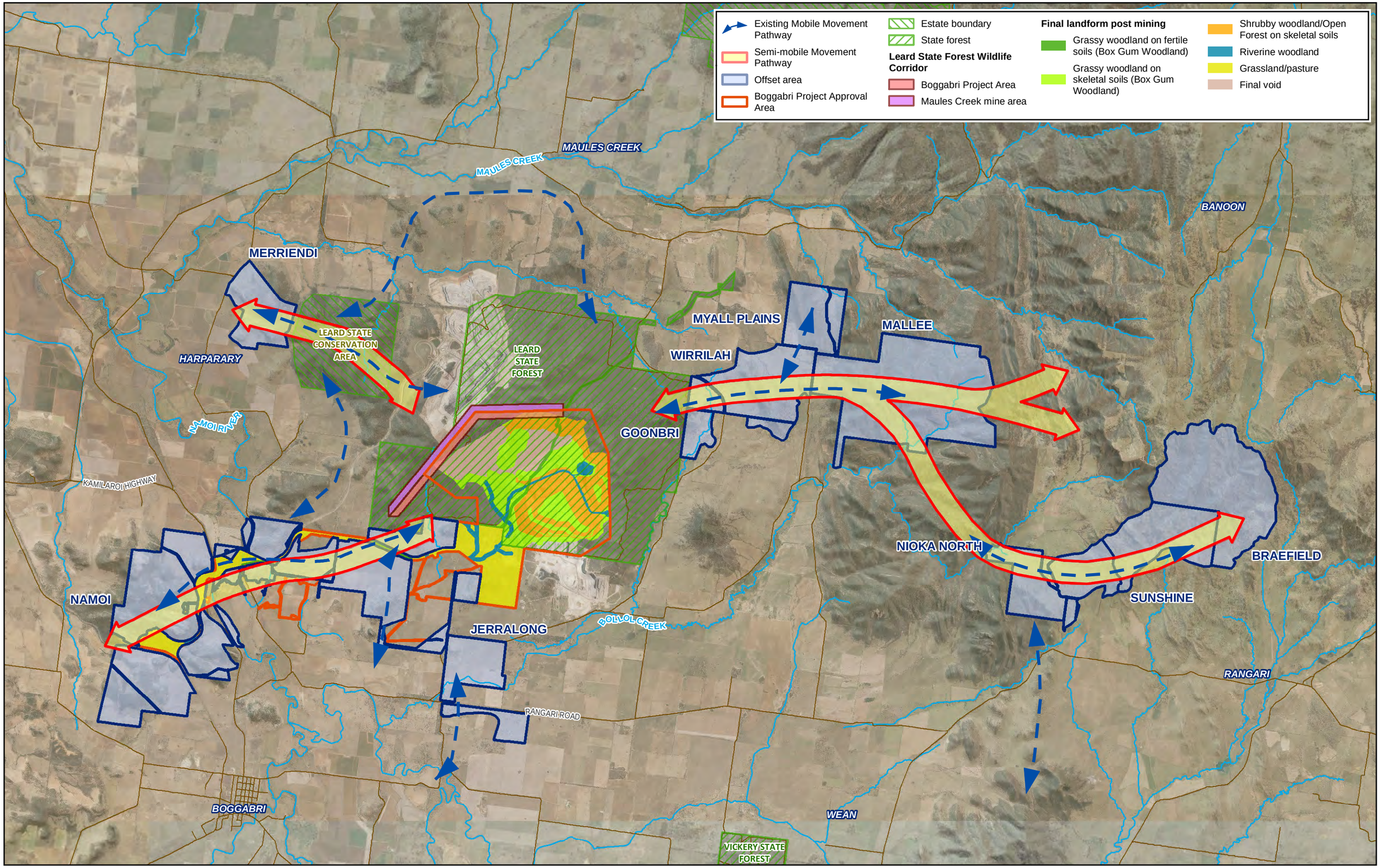
Organisation	Contact Details
Gunnedah Veterinary Hospital	14-16 Barber Street, Gunnedah 02 6742 1834
Wildlife Information and Rescue Service (WIRES) Central Northern Branch	1300 131 554
Waterways Wildlife Park - wildlife carer	Oxley Highway, 7 km West of Gunnedah 02 6742 1826

1.6 Integration of Biodiversity Offsets and Mine Rehabilitation

A history of intensive agriculture land use comprising primarily sheep and wheat activities dominates the project locality. These activities resulted in the isolation of the Leard State Forest remnant from other isolated remnants within locality and region. Historically, the Nandewar Range, Leard State Forest and Namoi River floodplain were once linked by a contiguous corridor of native vegetation. The Boggabri Coal BOS has been developed with the intention of recreating habitat linkages within this important environmental corridor, linking existing remnant patches of native vegetation and increasing the overall biodiversity value of the area. The re-establishment of the Regional East-West Wildlife Corridor will facilitate the movement of threatened species throughout the region and provide for the conservation and restoration of large areas of threatened ecological communities, including Box Gum Woodland.

Boggabri Coal have acquired 10 BOAs for inclusion into the revised BOS to recreate linkages within the Regional East-West Wildlife Corridor. These properties have been selected based on their conservations values (commensurate with the impacts of the project) and their location within the Regional East-West Wildlife Corridor.

Boggabri Coal has developed a Rehabilitation Management Plan (RMP) (Boggabri Coal Operations 2015) to guide the rehabilitation of the mining activities for the site and in the case of closure, rehabilitation of remaining infrastructure. The mine rehabilitation strategy for the Project will focus on biodiversity and establishment of habitat for threatened species and will form part of the regional east-west wildlife corridor created as part of the BOS. The final land use and rehabilitation strategy for the Project will be undertaken to ensure consistency with the National Recovery Plan for White Box – Yellow Box – Blakely's Red Gum woodland and Derived Native Grassland. Accordingly, targeted revegetation off the post mine landscape to natural vegetation communities and habitat for threatened species, will be managed for biodiversity conservation. As a consequence, the BMP and RMP are necessarily integrated to manage for local and regional biodiversity outcomes. The 10 BOAs and mine rehabilitation area that will form the Regional East-West Wildlife Corridor is illustrated in Figure 1.2.



0 0.5 1 1.5 2 2.5 3 kilometres

Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
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MINE NAME.	2171706A_GIS_BMP029_A1
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

FIGURE 1.2

TITLE. INTERACTION OF BIODIVERSITY OFFSETS AND MINE REHABILITATION

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2. Existing environment

Biodiversity values within the Project Boundary and BOAs are summarised in Sections 2.1 and 2.2 respectively. A summary of the locality is provided in Table 2.1 below.

Table 2.1 Locality information

Criteria	Location
Council	Narrabri and Gunnedah
CMA	Namoi
CMA sub-region	Liverpool Plains, Peel
Bioregion	Brigalow Belt South, Nandewar
Mitchell landscapes	§ Project Boundary: Liverpool Alluvial Plains, Mooki - Namoi Channels and Floodplains, Bugaldie Uplands § Mallee BOA: Tamworth - Keepit Slopes and Plains, Split Yard Plateau, Bugaldie Uplands § Merriendi BOA: Bugaldie Uplands, Liverpool Alluvial Plains § Myall Plains BOA: Tamworth - Keepit Slopes and Plains, Liverpool Alluvial Plains § Namoi BOA: Liverpool Alluvial Plains, Mooki - Namoi Channels and Floodplains, Upper Namoi Swamps and Lagoons, Bugaldie Uplands, Cubbo Uplands § Goonbri BOA: Bugaldie Uplands § Jerralong BOA: Liverpool Alluvial Plains § Wirrilah BOA: Tamworth — Bugaldie Uplands, Liverpool Alluvial Plains, Tamworth — Keepit Slopes and Plains § Sunshine BOA: Liverpool Alluvial Plains, Tamworth – Keepit slopes and Plains § Nioka North BOA: Liverpool Alluvial Plains, Tamworth – Keepit slopes and Plains § Braefield BOA: Tamworth – Keepit slopes and Plains.

2.1 Project boundary

A large portion of the land within the Project Boundary is located within Leard State Forest, which covers an area of 8,134 ha, the majority of which is natural vegetation. Surrounding land uses include mineral extraction and rural activities, including pasture improvement, cropping and cattle grazing.

The mining portion of the Project Boundary lies within a large relatively intact patch of remnant vegetation surrounded by a landscape that has been modified significantly through anthropogenic disturbance associated with the above listed land uses. The biodiversity values of the Project Boundary have been extensively assessed and documented from concept studies completed in 1976, to detailed surveys recently completed for the continuation of mining submission.

Ecological surveys have been completed within the locality as part of the following studies:

- Boggabri Coal Biodiversity Monitoring Programs, which include:
  - Annual Leard State Forest Biological Monitoring (2006 to 2017)

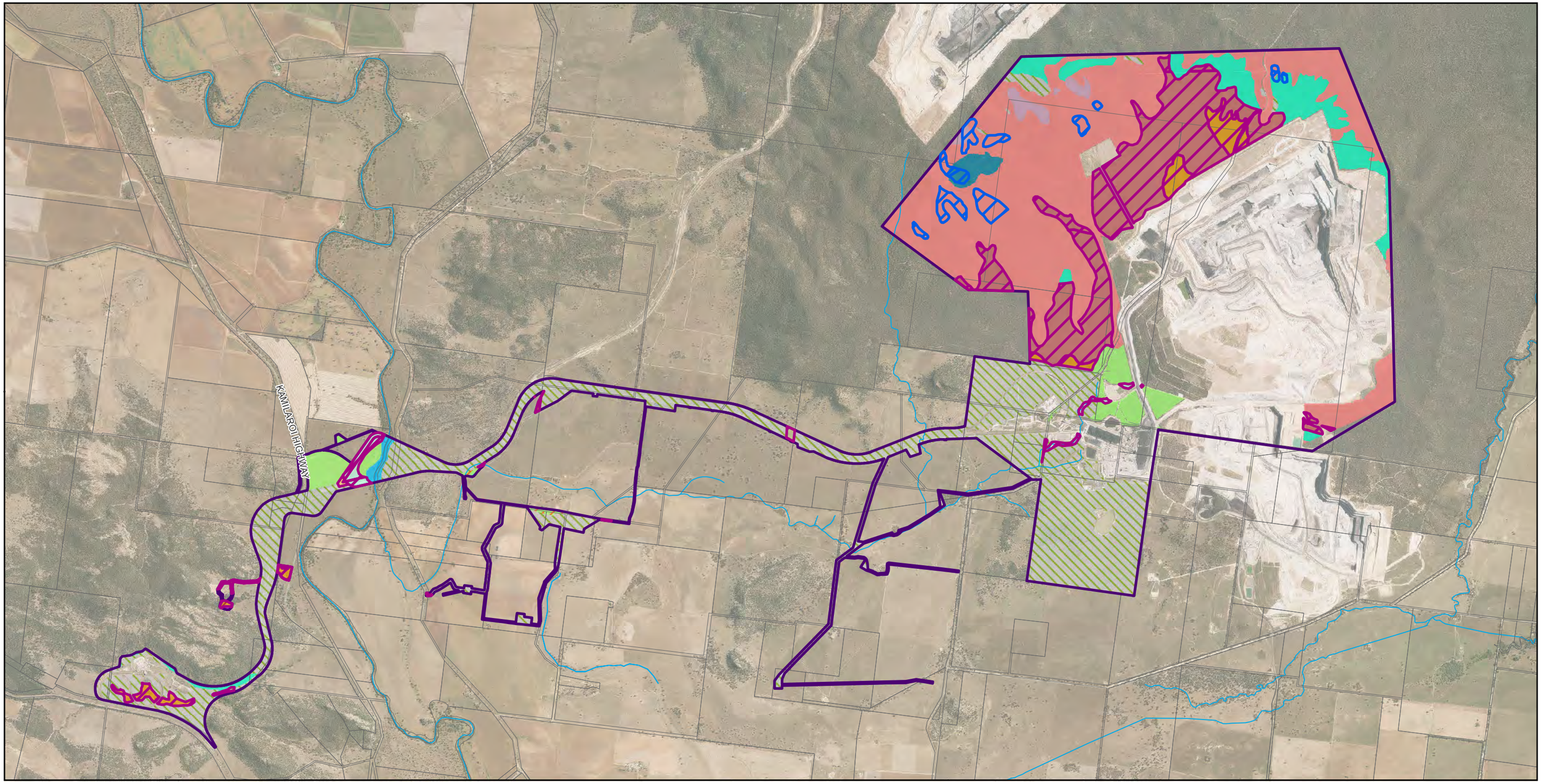
- Annual Biodiversity Corridor Monitoring (2013 to 2017)
- Annual Mine Rehabilitation Area Monitoring (2012 to 2017)
- Annual BOA Monitoring (2012 and 2014 to 2017).

- Boggabri Coal – Biodiversity Survey Report for Braefield {Parsons Brinckerhoff, 2015 #7739}
- Boggabri Coal – Biodiversity Survey Report for Sunshine and Nioka North (Parsons Brinckerhoff 2015)
- Project modification ecological assessments
- Goonbri Road Upgrade Ecological Assessment
- *Continuation of Boggabri Coal Mine — Biodiversity Impact Assessment* (Parsons Brinckerhoff 2010a).
- *Preliminary vegetation mapping and survey report for Boggabri Coal lease* (Parsons Brinckerhoff 2009).
- *Flora and Fauna Summary of the Boggabri Coal Project* (Parsons Brinckerhoff 2005).
- *Results of Fauna survey work undertaken by the NSW National Parks and Wildlife Service within Leard State Forest* (Pennay 2001).
- *Report on the botany, wildlife and ecology of the Leard State Forest. Draft Environmental Impact Statement for Amax-BHP Joint Venture Boggabri Coal Project* (James B. Croft and Associates 1983).
- *Boggabri Coal Mine Independent Biodiversity Offsets Audit (Niche Environment and Heritage 2014).*

Biodiversity values within the Project Boundary are described in Sections 2.1.1 and 2.1.2. This information is based on findings of previous studies noted above, particularly the results of seasonal surveys completed between December 2008 and September 2009 for the *Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment* (Parsons Brinckerhoff 2010a).

2.1.1 Flora

Flora values within the Project Boundary are illustrated in Figure 2.1 below and described in the following sections.



Boggabri Project Approval Area

Threat-listed flora area

Threat-listed ecological community

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [PCT102/NA181]

Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion

Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion [PCT1380/NA163]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT78/NA193]

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT78/NA193]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [PCT27/NA219]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1384/NA227]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1384/NA227]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

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Scale 1:50,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018);

IDEMITSU BOGGABRI COAL

MINE NAME. 2171706A_GIS_BMP019_A1

AUTHOR. SuansriR

CHECKED BY. N.Cooper

DATE. 4/09/2018

FIGURE 2.1

TITLE. FLORA VALUES WITHIN THE PROJECT AREA

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2.1.1.1 Vegetation communities

Sixteen (16) distinct vegetation communities have been recorded in the Project Boundary (Parsons Brinckerhoff 2010) (Figure 2.1).

2.1.1.2 Threatened ecological communities

Three ecological communities listed under the EPBC Act, three ecological communities listed under the *Biodiversity Conservation Act 2016* (BC Act) (formerly the *Threatened Species Conservation Act 1995* (TSC Act)) and one ecological community listed under the *Fisheries Management Act 1994* (FM Act) have been recorded within the Project Boundary (Parsons Brinckerhoff 2010a) (Table 2.2).

Table 2.2 Threatened ecological communities and corresponding vegetation communities within the project boundary

Threatened ecological community	Corresponding vegetation community within the project boundary[1]	Area removed within project boundary (ha)
EPBC Act		
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered	§ White Box – White Cypress Pine grassy woodland § White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest § Yellow Box – Blakely's Red Gum grassy woodland	629.3
Weeping Myall Woodlands — Endangered	§ Weeping Myall grassy open woodland	0.4
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Qld – Critically Endangered	§ Plains Grassland	0.5
BC Act		
White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Grassy Woodland)	§ White Box – White Cypress Pine grassy woodland § White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest § Yellow Box – Blakely's Red Gum grassy woodland	This community corresponds with the EPBC Act listing
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions	§ Weeping Myall grassy open woodland	As above
Native Vegetation on Cracking Clay Soils of the Liverpool Plains	§ Plains Grassland	As above
FM Act		
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River[2]	The Namoi River and several creeks within the Project Boundary are included in the determination for this aquatic ecological community (River Red Gum Riparian Woodlands and Forests)	2.8

Note:
1. Refer to Figure 2.1.

2.1.1.3 Threatened flora species

A review of biodiversity databases indicates that 12 threatened flora species have been recorded or are predicted to occur within 20 km of the Project Boundary. Two of these threatened flora species were recorded within the Project Boundary during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a) (Figure 2-1):

- *Pultenaea setulosa* - listed as Vulnerable under the EPBC Act
- *Pomaderris queenslandica* - listed as Endangered under the BC Act.

An additional threatened species *Tylophora linearis* was identified within the Project Boundary and 2014 clearing area during seasonal surveys undertaken between May and July 2014 (Parsons Brinckerhoff 2014).

A further two threatened flora species have potential to occur in the Project Boundary with a moderate or greater likelihood (Table D-1, Appendix D):

- *Digitaria porrecta* - listed as Endangered under the EPBC Act and BC Act
- *Diuris tricolor* - listed as Vulnerable under the EPBC Act and BC Act.

2.1.1.4 Introduced and noxious weeds

Seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a) recorded 61 species of introduced plants within the Project Boundary. Of the introduced species recorded, nine were declared Class 4 Weeds under the *Noxious Weeds Act* 1993 (NW Act) (now repealed and replaced by the *Biosecurity Act 2015* (Biosecurity Act) for the Narrabri weed control area and one (*Rubus ulmifolius*) is classified additionally as a Weed of National Significance (WoNS) (Weeds Australia 2011) and four are now listed as priority weeds under the Biosecurity Act:

- *Conium maculatum* (Hemlock)
- *Heliotropium amplexicaule* (Blue Heliotrope)
- *Opuntia aurantiaca* (Tiger Pear)
- *Opuntia stricta* (Prickly Pear)
- *Opuntia tomentosa* (Velvet Tree Pear)
- *Oxalis corniculata*
- *Rubus ulimifolius* (Blackberry)
- *Sclerolaena birchii* (Galvanised Burr)
- *Xanthium sp.*

Additional surveys undertaken within the Project Boundary (refer to Section 2.1) have identified an additional two weed species listed under the NW Act, Biosecurity Act and/or are WoNS. These species include:

- *Lycium ferocissimum* (African Boxthorn)
- *Phyla canescens* (Fog-fruit).

A Weed and Pest Management Strategy for the Project Boundary is provided as Appendix C of this BMP.

2.1.2 Fauna

Fauna values within the Project Boundary are illustrated in Figure 2.2 and described in the following sections.

2.1.2.1 Fauna habitat types

The suitability, size and configuration of the fauna habitats within the Project Boundary correlate broadly with the structure and quality of the local and regional vegetation types (refer Section 2.1.1.1 and Figure 2.2). Fauna habitats, particularly those located in the Leard State Forest, provide moderate to good condition habitat for a range of woodland birds, mammals (microchiropteran bats) and reptiles.

Habitat features recorded in the Project Boundary generally include those associated with grassy woodlands on fertile soils, shrubby woodlands/open forest on skeletal soils, riverine woodland and derived/ exotic grassland (Figure 2.2).

Key aquatic habitats within the Project Boundary are associated with the Namoi River and its floodplain. Additional aquatic habitat features include minor ephemeral streams within the proposed open cut disturbance area and permanent water sources associated with artificial drainage contours and dams.

2.1.2.2 Threatened fauna species

A review of biodiversity databases indicates that 67 threatened fauna species have been recorded or are predicted to occur within 20 km of the Project Boundary.

Twenty-one (21) of these threatened fauna species (15 birds and six mammals) were recorded within the Project Boundary during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a). A further 10 threatened fauna species (one frog, five birds, three mammals and one reptile) have a moderate or greater likelihood of occurring within the Project Boundary (Table D-2, Appendix D).

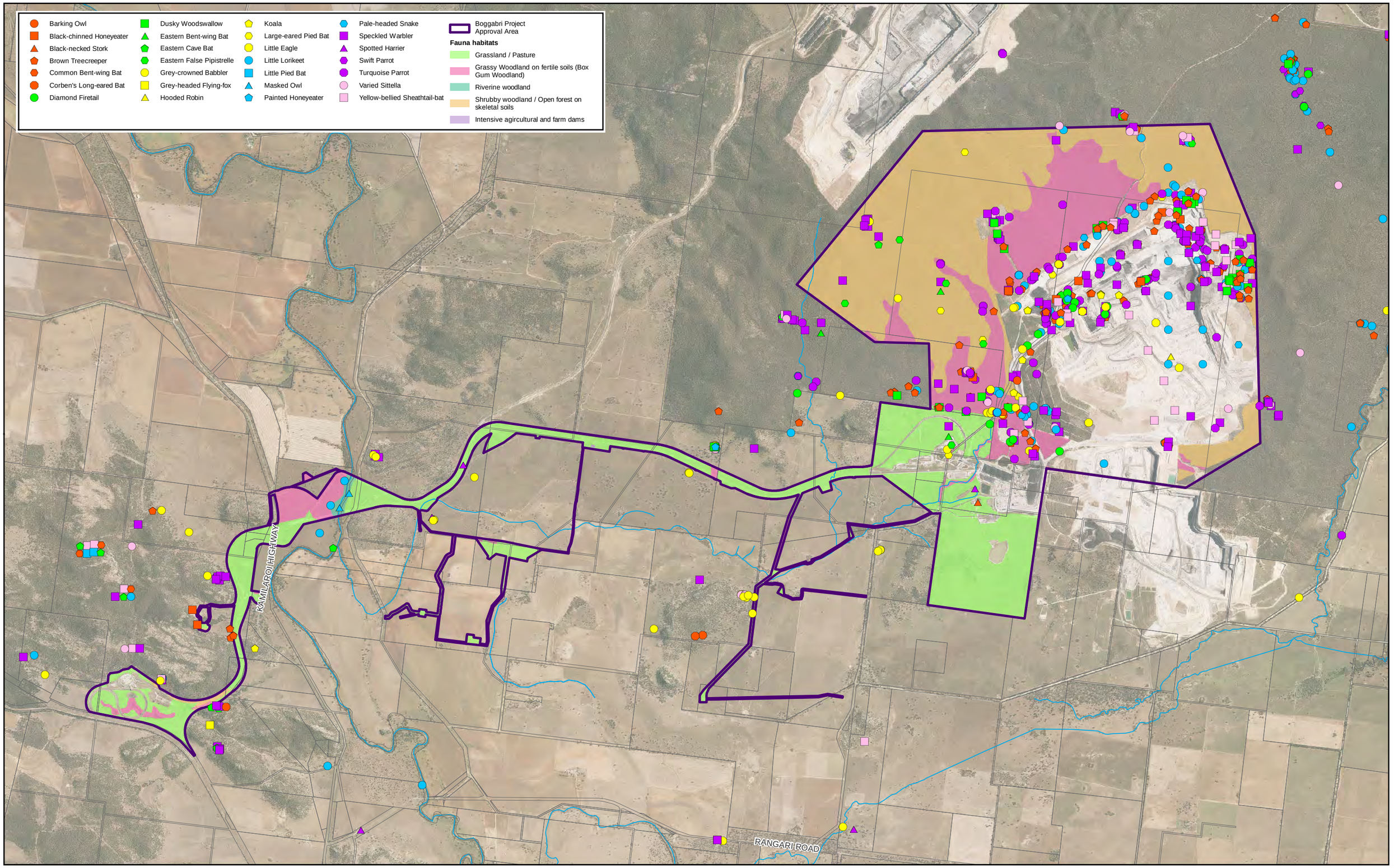
2.1.2.3 Migratory species

Two species of bird (White-throated Needletail and Satin Flycatcher) listed under the migratory provisions of the EPBC Act were recorded during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a).

2.1.2.4 Introduced fauna and pest species

Seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a) recorded seven species of feral animal including Common Starling, Fox, Brown Hare, Rabbit, Black Rat, Common House Mouse and Pig.

A Weed and Pest Management Strategy for the Project Boundary is provided as Appendix C of this BMP.



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Imagery:
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IDEMITSU BOGGABRI COAL

MINE NAME.	2171706A_GIS_BMP020_A1
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
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FIGURE 2.2

TITLE. FAUNA VALUES WITHIN THE PROJECT AREA

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2.2 Biodiversity offset areas

The ten BOAs owned by BCOPL contain large patches of remnant vegetation and high quality habitats adjoining existing vegetated lands. Securement of these properties under a freehold title provides additional conservation areas in the region for threatened flora and fauna which have been highly fragmented since European settlement. The biodiversity values of each BOA are summarised in Table 2.3 and mapped in detail within the relevant BOA Management Plan provided as Appendix E. The quantity, quality and ecological characteristics of the offset areas have been validated by the independently approved ecological expert (Niche Environment and Heritage 2014).

Table 2.3 Summary of biodiversity values within the BOAs

Offset	Habitats			Site photos	Threatened biodiversity		
	Habitat type	Area (ha)	Habitat features		Recorded threatened species	Potential threatened species habitat	Threatened ecological communities
Eastern Offsets							
Nioka North	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby Woodlands/Open Forest on skeletal soils Other land (intensive agriculture)	269.6 115.1 176.4 278.6 17.9	This property contains good condition areas of both grassy and shrubby woodland, which occur predominantly along the eastern and western boundaries of the property. The ridgelines within the property contain conglomerate outcropping providing habitat for a range of herpetofauna. The property contains a large number of White Box trees which contain hollows suitable for birds, tree frogs, arboreal mammals and hollow-dwelling microbats.	 Yellow Box Grassy Woodland in the north west  Shrubby woodland in the centre of Nioka North	Brown Treecreeper Grey-crowned Babbler Speckled Warbler Little Lorikeet Turquoise Parrot Black-chinned Honeyeater Diamond Firetail Varied Sittella Squirrel Glider Corben's Long-eared Bat Large-eared Pied Bat	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Spotted Harrier, Square-tailed Kite, Barking Owl, Masked Owl, Hooded Robin, Pied Honeyeater, Painted Honeyeater, Superb Parrot, Black Falcon, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle) **Other mammals** (Koala, Spotted-tailed Quoll) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Digitaria porrecta, Pomaderris queenslandica, Diuris tricolor, Tylophora linearis*)	Box Gum Woodland State 1 (Woodland): 291.5 ha State 2: (Native Pastures): 265.2 ha
Sunshine	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby Woodlands/Open Forest on skeletal soils	248.8 171.5 81.2 151.8	The northern edges of Sunshine contain areas of grassy and shrubby woodland with significant regeneration, particularly along ridgetops and drainage lines. There are areas of riparian grassy woodland vegetation throughout the property, which have good restoration potential. Along the western boundary of the property a locally restricted community occurs. This community occurs on andesite geology and contains locally restricted plants and grass trees which is likely to be regionally significant vegetation.	 Grassy Woodland in the north of the property 	Brown Treecreeper Little Lorikeet Speckled Warbler Turquoise Parrot Grey-crowned Babbler	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Hooded Robin, Black-chinned Honeyeater, Pied Honeyeater, Painted Honeyeater, Diamond Firetail, Varied Sittella, Little Eagle, Spotted Harrier, Square-tailed Kite, Superb Parrot, Black Falcon, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Digitaria porrecta, Diuris tricolor, Pomaderris queenslandica, Tylophora linearis*)	Box Gum Woodland State 1 (Woodland) 240.5 ha State 2 (Native Pastures) (248.8 ha)

Offset	Habitats			Site photos	Threatened biodiversity		
	Habitat type	Area (ha)	Habitat features		Recorded threatened species	Potential threatened species habitat	Threatened ecological communities
	Other land (intensive agriculture)	84.7		Grass Trees in locally restricted vegetation on Western boundary			
Braefield	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby woodlands open forest on skeletal soils Other land (intensive agriculture and farm dams)	55.4 197.1 165.1 982.7 0.4	The northern portion of this property contains a large area of intact good condition native bushland which has a variety of habitats. This area contains a large bluff with cliff lines and caves suitable for threatened microbats. This area of intact bushland also contains large hollow-bearing trees and dense understorey and ephemeral creeklines which provide significant habitat for a number of woodland birds, mammals and herpetofauna. The southern portion of this BOS contains large areas of good condition White Box grassy woodland and native grassland. Along the southern boundary, the property contains an area of extensive agriculture and to the south west contains an area of remnant White Box woodland which would respond well to regeneration.	 Bluff and Shrubby Woodland in the north of the property  Good Condition Grassy White Box Woodland	Brown Treecreeper Little Lorikeet Speckled Warbler Turquoise Parrot Varied Sittella Hooded Robin Grey-crowned Babbler Diamond Firetail Dusky Woodswallow	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Black-chinned Honeyeater, Painted Honeyeater, Little Eagle, Spotted Harrier, Square-tailed Kite, Black Falcon, Superb Parrot) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll, Grey-headed Flying-fox) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*)	Box Gum Woodland State 1: (Woodland):194.3 ha State 2: (Native Pastures) 55.4 ha
Central Offsets							
Mallee	Grassland Grassy Woodland on fertile soils Riverine Woodland	40.3 14.2 18.9	The majority of the Mallee BOA site supports woodland habitats of good quality with very few edge effects. A diverse shrub layer is present. Large areas of rocky outcrops and cliff lines are likely to provide significant roosting and potential maternity sites for microchiropteran bats (microbats).		Brown Treecreeper Diamond Firetail Grey-Crowned Babbler Hooded Robin Little Eagle Little Lorikeet Speckled Warbler	**Nomadic species**, (Regent Honeyeater, Swift Parrot) **Birds** (Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Masked Owl, Barking Owl, Spotted Harrier, Square-tailed Kite, Superb Parrot, Black Falcon) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, and Large-eared Pied Bat)	Box Gum Woodland State 1 (Woodland): 14.2 ha

Offset	Habitats			Site photos	Threatened biodiversity		
	Habitat type	Area (ha)	Habitat features		Recorded threatened species	Potential threatened species habitat	Threatened ecological communities
	Shrubby Woodlands/Open Forest on skeletal soils	1,992.8	A dam and the "Dripping Rock" water hole in the central and southern areas of the Mallee BOA are likely to provide a significant watering point for local fauna.	"Dripping Rock" adjacent to southern Mallee boundary  Central cliff line in the Mallee BOA	Turquoise Parrot Varied Sittella Dusky Woodswallow	**Other mammals** (Brush-tailed Rock Wallaby, Spotted-tailed Quoll, and Koala) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Pomaderris queenslandica, Digitaria porrecta* and *Diuris tricolor*)	
Myall Plains	Grassland Grassy Woodland on fertile soils Shrubby Woodlands/Open Forest on skeletal soils Other land (intensive agriculture)	62.0 66.5 300.9 43.9	The Myall Plans BOA comprises woodland habitats in relatively good condition. The central portion hosts a large number of trees of varying ages. Some small areas of rock outcropping of a conglomerate origin are scattered across the BOA.	 Grassy Woodland along northern boundary  Central ridge of Myall Plains	Brown Treecreeper Hooded Robin Little Eagle Little Lorikeet Speckled Warbler Turquoise Parrot Grey-crowned Babbler Varied Sittella Barking Owl Corben's Long-eared Bat Eastern Cave Bat Yellow-bellied Sheathtail-bat Koala	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Diamond Firetail, Masked Owl, Barking Owl, Spotted Harrier, Square-tailed Kite and, Superb Parrot, Black Falcon) **Microbats** (Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Large-eared Pied Bat) **Other mammals** (Spotted-tailed Quoll, Squirrel Glider) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Digitaria porrecta* and *Diuris tricolor*)	Box Gum Woodland State 1 (Woodland): 66.5 ha State 2 (Native Pastures) 43.9 ha
Wirrilah	Grassland Grassy Woodland on fertile soils Shrubby Woodlands/Open Forest on skeletal soils Riverine Woodland	356.6 146.1 183.3 12.6	Much of the woodland within the Wirrilah BOA is in relatively good condition. Regeneration is present on many parts of the main ridge, particularly on the lower slopes. A small cliff-line traverses the southern side of the main east-west range which may provide roosting and maternity opportunities for microbats.	 Grassy Woodland on eastern property boundary 	Barking Owl Brown Treecreeper Grey-crowned Babbler Speckled Warbler Turquoise Parrot Varied Sittella Black Falcon Painted Honeyeater Swift Parrot (recorded by call during 2012 BOA inspections)	**Nomadic species** (Regent Honeyeater) **Birds** (Hooded Robin, Black-chinned Honeyeater, Pied Honeyeater, Diamond Firetail, Masked Owl, Varied Sittella, Spotted Harrier, Square-tailed Kite, Little Lorikeet, Superb Parrot, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Spotted-tailed Quoll, Squirrel Glider) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Digitaria porrecta* and *Diuris tricolor*)	Box Gum Woodland State 1 (Woodland): 146.1 ha State 2 (Native Pastures): 517.5 ha

Offset	Habitats			Site photos	Threatened biodiversity		
	Habitat type	Area (ha)	Habitat features		Recorded threatened species	Potential threatened species habitat	Threatened ecological communities
	Other land (intensive agriculture)	185.6		Shrubby Woodland within the centre of the property			
Goonbri	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby woodlands open forest on skeletal soils Other land (intensive agriculture)	88.3 0 72.3 55.3 15.1	This property contains areas of Box Gum woodland and remnant Box Gum Woodland (derived native grassland). This property adjoins the Wirrilah BOS and extends and enhances the biodiversity offset corridor. Habitat within the property includes grassy woodland, shrubby woodlands and grassland. These areas provided habitat for a range of threatened flora and fauna.	 Scrubby woodland within eastern side.  Good Condition White Box Grassy Woodland	Little Lorikeet Grey-crowned Babbler Speckled Warbler	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Brown Treecreeper, Speckled Warbler, Turquoise Parrot, Varied sittella, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Diamond Firetail, Little Eagle, Spotted Harrier, Square-tailed Kite, Black Falcon, Superb Parrot, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll, Grey-headed Flying-fox) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*)	Box Gum Woodland State 1 (Woodland): 72.3 ha State 2 (Native Pastures) 88.3 ha
Namoi Offsets							
Namoi[1]	Grassland	1,368.9	The western portion of the Namoi BOA contains significant areas of grassy and shrubby woodland with relatively few disturbances. Importantly this offset contains significant areas of floodplain vegetation including numerous natural soaks. This BOA immediately adjoins and borders a 7 km stretch of the Namoi River.	 Centre of the "Rocklea" property Shrubby White Box  River Red Gum Woodland along the Banks of Namoi after flooding.	Brown Treecreeper Black-chinned Honeyeater Diamond Firetail Painted Honeyeater Dusky Woodswallow Grey-crowned Babbler Koala Little Lorikeet Little Pied Bat Masked Owl Speckled Warbler Spotted Harrier Varied Sittella Yellow-bellied Sheathtail Bat Turquoise Parrot Corben's Long-eared Bat	**Nomadic species**, (Regent Honeyeater, Swift Parrot) **Birds** (Hooded Robin, Pied Honeyeater, Square-tailed Kite, Superb Parrot, Black Falcon) **Microbats** (Eastern False Pipistrelle, and Large-eared Pied Bat) **Other mammals** (Spotted-tailed Quoll) **Herpetofauna** (Border Thick-tailed Gecko, Sloane's Froglet) **Flora** (*Pomaderris queenslandica, Digitaria porrecta* and *Diuris tricolor*)	Box Gum Woodland State 1 (Woodland) 326.4 ha State 2 (Native Pastures) 590.1 ha Weeping Myall Woodland (EPBC Act and BC Act) 30.2 ha woodland and 2.3 ha of Derived Native Grasslands Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland (EPBC Act and BC Act) 20.3 ha Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River (FM Act) 68.6 ha of woodland and 94.0 ha of Derived Native Grasslands
	Grassy Woodland on fertile soils	567.6					
	Riverine Woodland	81.1					
	Shrubby Woodlands/Open Forest on skeletal soils	939					

Offset	Habitats			Site photos	Threatened biodiversity		
	Habitat type	Area (ha)	Habitat features		Recorded threatened species	Potential threatened species habitat	Threatened ecological communities
	Other land (intensive agriculture)	258.3			Eastern Bent-wing Bat Eastern Cave Bat *Tylophora linearis*		
Jerralong	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby woodlands open forest on skeletal soils Intensive agriculture and farm dams	300.8 0 209 13.4 46.9	This property contains large areas of Pilliga Box – Popular Box grassy woodland which is required for the offsets. It adjoins the Namoi Offsets to the north west extending the proposed regional corridor. Large areas of derived grassland which are likely to respond well to restoration are also present. A small area of riparian woodland is present and this provides habitat for threatened herpetofauna and foraging habitat for a number of threatened owls. The grassy woodlands provide habitat for a number of threatened flora and fauna species that are known to occur within the area.	 Narrow-leaved Ironbark Open Forest  Pilliga Box – Poplar Box Woodland	Yellow-bellied Sheathtail-bat Grey-crowned Babbler Spotted Harrier	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Brown Treecreeper, Little Lorikeet, Speckled Warbler, Turquoise Parrot, Varied sittella, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Diamond Firetail, Little Eagle, Square-tailed Kite, Black Falcon, Superb Parrot, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll, Grey-headed Flying-fox) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*)	NA
Western Offsets							
Merriendi	Grassland Grassy Woodland on fertile soils	154.9 177.7	The majority of the Merriendi BOA comprises woodland habitats considered to be of high quality. These are characterised by native grasses, fallen timber, leaf litter and loose rock. Many of the box trees host hollows suitable for small birds, arboreal mammals and reptiles, tree frogs and microbats.	 Derrived Grassland on southern lower slope	Brown Treecreeper Diamond Firetail *Digitaria porrecta* Eastern Cave Bat Grey-crowned Babbler Hooded Robin Speckled Warbler Dusky Woodswallow Masked Owl	**Nomadic species**, (Regent Honeyeater, Swift Parrot) **Birds** (Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Barking Owl, Spotted Harrier, Square-tailed Kite and Little Lorikeet, Superb Parrot, Black Falcon) **Microbats** (Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Spotted-tailed -Quoll, Koala, Squirrel Glider) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Pomaderris queenslandica, Diuris tricolor*)	Box Gum Woodland State 1 (Woodland) 176.1 ha State 2(Native Pastures) 150.5 ha Weeping Myall Woodland (EPBC Act and BC Act) 1.6 ha

Offset	Habitats			Site photos	Threatened biodiversity		
	Habitat type	Area (ha)	Habitat features		Recorded threatened species	Potential threatened species habitat	Threatened ecological communities
	Shrubby Woodlands/Open Forest on skeletal soils	150.6		 Shrubby Woodand on steep central ridge			

Notes:

1. The Namoi BOA includes the following properties: Boggabri Coal/Aston Crown Perpetual Lease, Belleview, Daisymede, Eastview, Heathcliffe, Jeralong North, Jeralong East, Jeralong, Northam-Jeralong East, Merriown, Mt Deh, Nagero, Special Lease/Crown land, land purchased as a joint venture between Boggabri Coal Mine and the Maules Creek Coal Mine, BCOPL owns 50% of land purchased under this joint venture agreement, Springfield, The Rock, Velyama and Victoria Park.

3. Potential and known impacts

The Boggabri Coal Project was approved under the Project Approval 09_0182 under Section 75J of the EP&A Act. Known and potential impacts associated with the Boggabri Coal Project were comprehensively assessed and documented in the *Continuation of Boggabri Coal Mine Environmental Assessment* (Project EA) (Hansen Bailey 2010). BCOPL subsequently applied for modifications of the Project Approval, to modify the Project's approval boundary for additional activities and ancillary infrastructure. Environmental Assessments and associated approvals in accordance with the EP&A Act have been completed for Modifications 3, 4 and 5. In addition to the Project's modifications, BCOPL has made commitments to provide additional offsets for impacts associated with the Goonbri Road Upgrade assessed under Part 5 of the EP&A Act and non-approved clearing of understory vegetation outside of the approved Project Boundary.

The most significant impact of the Project comprises the disturbance of native vegetation and associated habitats. Approximately 1,458.5 ha of native vegetation will be disturbed, including 637.8 ha of threatened ecological communities (refer Table 3.1).

The BOS has been carefully designed to provide a robust offsets package that will conserve regionally significant biodiversity and in the medium to long term improve ecological outcomes.

Through the protection and management of BOAs, the environmental offset package delivers a total average offset ratio of 5.5:1 (excluding rehabilitation completed in mine disturbance areas). That is, for every 1 ha of native vegetation removed, 5.5 ha will be protected and managed for conservation purposes. Table 3.1 details the extent of native vegetation removal required for the Project and the offset ratio achieved through the securement and management of the BOAs.

Table 3.1 Extent of vegetation removal and biodiversity offsets

Vegetation community	Plant Community Type (PCT)	Threatened ecological community	Total project disturbance (ha)[7]	Available offsets within revised BOS[5]		
				'Like for Like' (ha)[6]	Derived Native Grassland (ha)[6]	Total vegetation offset (ha)[6,8]
Threatened ecological communities						
Box Gum Woodland[1,2]	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [NA226, PCT 1383] and Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [NA237, PCT1329] and Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion – (grassy variant) [NA197, PCT1118]	White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland[1,2]	634.1	1,527.9	1,959.7	3,487.6
Plains Grassland CEEC[1,2]	Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [NA181, PCT102]	Plains Grassland[1,2]	0.5	20.3	0	20.3
Weeping Myall Woodland EEC[3]	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [NA219, PCT27]	Weeping Myall Woodland[3]	0.4	31.8	2.3	34.1
Natural Drainage System of the Lowland Catchment of the Darling River EEC[4]	River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT 78 / BVT NA 193]	Natural Drainage System of the Lowland Catchment of the Darling River (River Red Gum Riverine woodlands)[4]	2.8	68.6	94.0	162.6
Subtotal threatened ecological communities			**637.8**	**1,648.6**	**2,056.0**	**3,704.6**
Non-threatened vegetation communities						

Vegetation community	Plant Community Type (PCT)	Threatened ecological community	Total project disturbance (ha)[7]	Available offsets within revised BOS[5]		
				'Like for Like' (ha)[6]	Derived Native Grassland (ha)[6]	Total vegetation offset (ha)[6,8]
Dwyer's Red Gum woodland	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [NA245, PCT610]	-	0.3	390.6	29.2	419.8
Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest	Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion [NA163, PCT1380]	-	14.8	0	0	0
Pilliga Box – Poplar Box – White Cypress Pine grassy open woodland	Pilliga Box – White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [NA179, PCT88]	-	85	417.3	836.8	1,254.1
White Box – Melaleuca riverine forest	River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [NA191, PCT84]	-	0.6	36.3	0	36.3
Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [NA228, PCT1313]	-	532.3	2,219.1	47.3	2,266.4
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (shiny bush) Regrowth – White Cypress Pine	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)		184	1,140.2	110.5	1,250.7
Silver-leaved Ironbark heathy woodland	White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion [NA231, PCT1307]	-	3.7	231.2	7.9	239.1

Vegetation community	Plant Community Type (PCT)	Threatened ecological community	Total project disturbance (ha)[7]	Available offsets within revised BOS[5]		
				'Like for Like' (ha)[6]	Derived Native Grassland (ha)[6]	Total vegetation offset (ha)[6,8]
Tumbledown Red Gum grassy woodland Myrtle Shrubland (+- White Pine/Tumbledown Red Gum); Dripping Rock	Cypress pine – Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [NA410, PCT427]	-	0	169.3	0	169.3
White Box – White Cypress Pine shrubby open forest (including White Cypress Pine regrowth and Shiny Bush)	White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	-	0	896.7	0	896.7
Rough Barked Apple Riparian Forbs/Grassy Forest	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	-	0	187.8	0	187.8
New England Blackbutt Rough-barked Apple shrubby open forest	Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion [NA162, PCT542]	-	0	1.3	0	1.3
Belah alluvial woodlands	Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region [NA102, PCT55]	-	0	2.7	65.3	68.0
Intensive agriculture Exotic grassland	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	-	0	0	0	147.4
Farm dams	Miscellaneous Ecosystems – water bodies, rivers, lakes, streams (not wetlands)	-	0	0	0	1.0

Vegetation community	Plant Community Type (PCT)	Threatened ecological community	Total project disturbance (ha)[7]	Available offsets within revised BOS[5]		
				'Like for Like' (ha)[6]	Derived Native Grassland (ha)[6]	Total vegetation offset (ha)[6,8]
Other land for agriculture	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation					276.7
Subtotal other remnant vegetation			**820.7**	**5,692.5**	**1,097.0**	**7,214.6**
Total			**1,458.5**	**7,341.1**	**3,153.0**	**10,919.2**
Grassy Woodland on fertile soils			676.6	1,676.1		
Shrubby Woodlands/Open Forest on skeletal soils			735.1	5,048.4		
Riverine Woodland			3.4	596.3		
Grassland			43.4	2,945.6		
Intensive agriculture and farm dams (including other land for agriculture)			0	652.8		
Total fauna habitats			**1,458.5**	**10,919.2**		

(1) Critically Endangered Ecological Community, listed under EPBC Act.
(2) Endangered Ecological Community, under the BC Act.
(3) Endangered Ecological Community, under the EPBC Act and the BC Act.
(4) Endangered Ecological Community, under the FM Act.
(5) Excluding rehabilitation of the mine disturbance area for conservation outcomes
(6) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this BMP, totalling 3,214.9 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.
(7) Areas include Continuation of Boggabri Coal EA, Modification 3, Modification 4, Modification 5, inadvertent clearing outside the project boundary and Goonbri Road Upgrade.
(8) The total vegetation offsets include surplus areas of vegetation to current offset requirements

Vegetation communities to be disturbed during the Project provide known and potential habitat for many threatened species of fauna and flora. Significance assessments completed for the Project EA (Hansen Bailey 2010) concluded that the Project will have a significant and long-lasting impact on the habitat of ten species of bird, three species of microbat and the Box Gum Grassy Woodland ecological community as listed under the BC Act and the equivalent community listed under the EPBC Act (Table 3.2).

Table 3.2 Summary of significance assessments completed for the Project

Biodiversity values	Recorded in Project Boundary	BC Act[1]	FM Act[2]	EPBC Act[3]	Likely significant impact
Endangered Ecological Communities					
Box Gum Grassy Woodland	Yes	E		CE	Yes
Weeping Myall Woodland	Yes	E		E*	No
Plains grassland	Yes	E		CE	No
Natural Drainage System of the Lowland Catchment of the Darling River			E		No
Threatened plants					
Digitaria porrecta	No	E		E	No
Diuris tricolor	No			V	No
Pomaderris queenslandica	Yes	E			No
Pultenaea setulosa	Yes			V	No
Tylophora linearis	Yes	V		E	No
Threatened animals					
Sloane's Froglet	No	V			No
Threatened woodland birds assessed as a group (Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella[4])	Yes	V			Yes
White-browed Woodswallow[4]	Yes	V[5]			No
Spotted Harrier	Yes	V			No
Little Lorikeet	Yes	V			No
Little Eagle	Yes	V			No
Swift Parrot	No	E		CE	No
Square-tailed Kite	No	V			No
Turquoise Parrot	Yes	V			No
Barking Owl	Yes	V			No
Masked Owl	Yes	V			No
Superb Parrot	No	V		V	No
Regent Honeyeater	No	CE		CE	Yes
Black-necked Stork	Yes	V			No

Biodiversity values	Recorded in Project Boundary	BC Act[1]	FM Act[2]	EPBC Act[3]	Likely significant impact
Threatened hollow-dependent microchiropteran bats assessed as a group (Eastern False Pipistrelle, Corben's Long-eared Bat and Yellow-bellied Sheath-tail Bat)	Yes	V		V[5]	Yes
Threatened cave-dependent microchiropteran bats assessed as a group (Eastern Cave Bat, Eastern Bent-wing Bat, Large-eared Pied Bat and Little Pied Bat		V		V[5]	No
Spotted-tailed Quoll	No	V		E	No
Squirrel Glider	No	V			No
Koala	Yes	V		V	No
Border Thick-tailed Gecko	No	V		V	No

(1) Biodiversity Conservation Act, V = Vulnerable, E = Endangered

(2) Fisheries Management Act, E = Endangered

(3) Environment Protection and Biodiversity Conservation Act 1999, CE = Critically Endangered, V = Vulnerable, E = Endangered, M = Migratory

(4) Preliminary listing at time of Project Environmental Assessment.

(5) Corben's Long-eared Bat and Large-eared Pied Bat only.

Section 6 of this BMP provides actions to mitigate and manage the operational impacts of the Project and BOAs, in accordance with the BOS. The construction of infrastructure associated with the Project has been finalised and the potential for impacts on biodiversity values were managed in accordance with the CEMP.

4. Statutory requirements

Relevant statutory requirements applicable to the Project are summarised in Table 4.1 and Table 4.2 and discussed briefly in this section together with relevant legislation, standards and guidelines, current as at the date of this BMP.

4.1 Commonwealth

The following Commonwealth statutory requirements associated with biodiversity management within the Project Boundary and BOAs have been considered during the development of this BMP.

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act protects Matters of National Environmental Significance (MNES), including migratory species and threatened species/ecological communities. Previous surveys and assessments have identified that the Project will impact upon EPBC Act listed ecological communities and native vegetation which provides potential habitat for threatened species including the Regent Honeyeater and Corben's Long-eared Bat (Table 4.1 and Table 4.2).

The EPBC Act Approval is subject to several conditions of approval imposed by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (now Minister for the Department of Environment and Energy (DoEE)) (refer Table 4.1).

Based on the potential impacts to MNES, the Project was determined to be a controlled action under the EPBC Act, with impact assessment and regulatory approval provided through a bilateral process (Part 3A of the EP&A Act), requiring approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities.

In regards to biodiversity offsets, the principles for the use of environmental offsets under the EPBC Act are outlined in the current *Environment Protection and Biodiversity Conservation Act 1999 Environmental Biodiversity Offsets Policy* (EPBC Act Offsets Policy). The objective of the EPBC Act Offsets Policy is to ensure the best environmental outcomes are achieved through the consistent, transparent and equitable application of offsets under the EPBC Act.

As the Project involves actions that affect MNES, offsets must be targeted to the aspect of the environment that is being impacted. An improved conservation outcome may be achieved by:

- improving existing habitat for the protected matter
- creating new habitat for the protected matter
- reducing threats to the protected matter
- increasing the values of a heritage place
- averting the loss of a protected matter or its habitat that is under threat.

The BOS has been designed with reference to the EPBC Act Offsets Policy and in consultation with DoEE. It is noted that assessment under the EPBC Act is only required for impacts resulting from Boggabri Coal Project granted under the Project approval, as all impacts associated with Boggabri Existing were historically approved under the *Environment Protection (Impact of Proposals) Act* 1974 (Cth), which did not necessitate the provision of biodiversity offsets.

Table 4.1 EPBC Act Approval conditions

Applicable Condition	Requirement	BMP Reference
Disturbance areas		
Condition 3	The person taking the action must submit a Biodiversity Corridor Plan for the approval of the Minister within three months of the date of this approval. The plan must address the following matters: § protection of native vegetation of a total width of 500 metres (m) where the Boggabri coal mine lease boundary is adjacent to the Maules Creek coal mine lease boundary § maintenance in perpetuity of this area as a biodiversity corridor § evidence that the biodiversity corridor will be protected in perpetuity through a legal mechanism that would provide the equivalent protection of a conservation covenant. The approved Biodiversity Corridor Plan must be implemented. Note: the definition of Biodiversity Corridor requires that any alternative corridor provides an equivalent or better ecosystem functionality (including habitat for the regent honey eater, swift parrot and greater long-eared bat)	Appendix J
Offset management plan		
Condition 12	To offset the impacts to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland and the habitat of the regent honeyeater, swift parrot and greater long-eared bat, the person taking the action must submit to the Minister for approval an Offset management plan for all of the offset areas, specified in condition 7, within 6 months of the date of this approval. The approved Offset management plan must be implemented prior to the commencement of new mining operations. Note: for consistency, the person taking the action may develop a Biodiversity Management plan that includes the requirements set for managing offsets as set out in these conditions, to align with the requirements of the NSW state government Project Approval dated 18 July 2012 (application number 09_0182) and this approval.	Appendix E
Condition 13	The *Offset management plan* must include, but not be limited to, the following information: § objectives to clearly identify baseline conditions of the offset sites, establish performance indicators and discuss methods for adaptive management § a text description and map to clearly define the location and boundaries of the offset areas. This must be accompanied by the offset attributes and shapefiles § a detailed survey and description (prior to any management activities, hence a baseline) of the current condition of the extant vegetation of each offset area. This must be consistent with the State and Transition Model, including but not limited to: } location of survey points (GPS reference) } vegetation condition mapping } photo reference points } tree age class representation } percentage tree canopy cover	Appendix E, F and Sections 6, 7, 8, 9 Table 2.3 and Appendix E Appendix K

Applicable Condition	Requirement	BMP Reference
	} number of native plant species in ground layer } percentage of nativeness of total plant groundcover (herbaceous plants and small shrubs, 1 m tall), measured using basal area. } description of fauna habitat including condition, type and connectivity } surveys of the regent honeyeater, swift parrot and greater long-eared bat § Plans to improve upon the baseline condition (identified in the surveys required by condition 13c) consistent with the State and Transition Model, EPBC listing advice, and threatened species habitat defined as native vegetation communities, including but not limited to: } a map showing areas to be managed } management actions for each area and details of management methods to be used } timing of management activity for each area } performance criteria for each area } a set of measurable ecological indicators for detecting changes to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community, including those that may be ascribed to ongoing water stress } a monitoring plan to assess the success of the management activities measured against the baseline condition. The monitoring must be statistically robust and able to quantify change in the condition of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community. This should include, but not be limited to, control sites and periodic ecological surveys to be undertaken by a qualified ecologist } a description of the potential risks to successful management against the performance criteria, and a description of the contingency measures that would be implemented to mitigate these risks } a process to report, to the department, the progress of management activities undertaken in the offset areas and the outcome of those activities, including identifying any need for improved management and activities to undertake such improvement } details of the various parties responsible for management, monitoring and implementing the management activities, including their position or status as a separate contractor.	Appendix E and F, Table 7.6 and Sections 7, 8 and 9

4.2 State

4.2.1 Environmental Planning and Assessment Act 1979

In summary, the EP&A Act facilitates mechanisms to encourage:

- proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment
- promotion and co-ordination of the orderly and economic use and development of land
- protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats
- sharing of the responsibility for environmental planning between the different levels of government in the State.

BCOPL was granted the Project Approval on 18 July 2012. Permits required under Section 75U of the EP&A Act do not apply to the Project however pursuant to Section 75V; BCOPL remains responsible for maintaining the following permits applicable to biodiversity management being:

- Mining Lease under the *Mining Act, 1992*
- Environmental Protection Licence (EPL) under the *Protection of the Environment Operations Act* 1997 (POEO Act).

Conditions of Project Approval issued by the Secretary of DP&I (now DP&E) relevant to biodiversity management within the Project Boundary and BOAs are detailed in Table 4.2 together with a reference to where these conditions are addressed in this BMP.

Table 4.2 Project Approval Conditions

Applicable Condition	Requirement	BMP Reference
Schedule 3, Condition 44	For the White Box - Yellow Box - Blakeley's Red Gum Grassy Woodland Endangered Ecological Community the Proponent shall: a) ensure that the Biodiversity Offset Strategy and Rehabilitation Strategy are focused on protection, rehabilitation, re-establishment and long-term maintenance of viable stands of this community b) investigate in consultation with OEH and the North West LLS, all factors likely to enhance or impede the effective long-term restoration of degraded remnants of this EEC in offset areas or regeneration of this EEC on disturbed areas (both offset areas and the site) c) within 24 months of the date of this approval (and if possible in conjunction with Stage 2 of the Leard Forest Mining Precinct Regional Biodiversity Strategy), submit a report of this investigation and provide an implementation plan to maximise the prospects for rehabilitation and regeneration of this EEC on the offset areas and the site, for approval by the Secretary, and d) incorporate the approved implementation plan into the revised Biodiversity Management Plan, required under condition 50.	Sections 1.3, 2.2, Table 3.1, Section 6 and 7 and Appendix F
Schedule 3, Condition 45	For all threatened species on site, the proponent shall ensure that the Biodiversity Offset Strategy and Rehabilitation Strategy are focussed on protection, rehabilitation and long-term maintenance of viable stands of suitable habitat for these species.	Appendices E and F
Schedule 3, Condition 46	The Proponent shall: a) investigate, in consultation with OEH and the North West LLS, all factors likely to enhance or impede the effective long-term provision of suitable habitat(s) for the following species: Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella, Regent Honeyeater, Eastern False Pipistrelle, Greater Long-eared Bat, Yellow-bellied Sheath Tail Bat b) within 24 months of the date of this approval (and if possible, in conjunction with Stage 2 of the Leard Forest Mining Precinct Regional Biodiversity Strategy), submit a report of this investigation and provide an implementation plan to ensure delivery of suitable areas of viable habitat for the species included in (a) above, for approval by the Secretary, and c) incorporate the approved implementation plan into the revised Biodiversity Management Plan, required under condition 50.	Appendix F
Schedule 3, Condition 48	Offset areas are to be managed primarily for the purposes of compensating for biodiversity impacts of the project and improving regional biodiversity outcomes. However, to the extent that limited agricultural production on the lots purchased for offsets is compatible with these objectives, the Biodiversity Management Plan and other conditions of this approval, the Proponent shall: d) include in the Biodiversity Management Plan an agricultural suitability assessment of surplus land on the offset properties, in particular for the proposed corridor enhancement zones, and e) maintain the agricultural productivity of the surplus areas.	Section 6.2.3 and Appendix G
Schedule 3, Condition 49	The Proponent shall prepare and implement a Biodiversity Management Plan for the project to the satisfaction of the Secretary. This plan must: a) be prepared in consultation with OEH, DoEE, CCC and the North West LLS, and be submitted to the Secretary for approval within 6 months of the date of this approval b) describe how the implementation of the biodiversity offset strategy would be integrated with the overall rehabilitation of the site	Sections 1.4.2, 6 and Appendix E and F

Applicable Condition	Requirement	BMP Reference
	c) describe the short, medium, and long term measures that would be implemented to: i) manage the remnant vegetation and habitat on the site and in the offset area/s (if and when applicable), and ii) implement the biodiversity offset strategy (if and when applicable), including detailed performance and completion criteria	Appendix F and Table 7.6
	d) include detailed performance and completion criteria for evaluating the performance of the biodiversity offset strategy, and triggering remedial action (if necessary)	Section 7.4 and 7.5
	e) include a detailed description of the measures that would be implemented including the procedures to be implemented for: i) enhancing the quality of existing vegetation and fauna habitat ii) restoring native vegetation and fauna habitat on the biodiversity areas and rehabilitation area through focusing on assisted natural regeneration, targeted vegetation establishment and the introduction of naturally scarce fauna habitat features iii) maximising the salvage of resources within the approved disturbance area - including vegetative, top and sub-soils and cultural heritage resources – for beneficial reuse in the enhancement of the biodiversity areas or rehabilitation area iv) collecting and propagating seed v) minimising the impacts on fauna on site, including undertaking pre-clearance surveys vi) improving the connectivity and corridor function of the offset areas to provide an east/west corridor to the Namoi River and demonstrating that this corridor is enhanced and maintained vii) managing any potential conflicts between the proposed restoration works in the biodiversity areas and any Aboriginal heritage values (both cultural and archaeological) viii) managing salinity ix) controlling weeds and feral pests x) controlling erosion xi) managing grazing and agriculture on site xii) controlling access xiii) bushfire management	Section 6, 7 and Appendix E and F
	xiv) Translocating and/or propagating the threatened flora species *Tylophora linearis* located within the project disturbance boundary – including details of methods and timing of propagation trials and programs and investigations into assisted natural regeneration in mine site rehabilitation and biodiversity offset areas.	Appendix L
	f) include a seasonally-based program to monitor and report on the effectiveness of these measures, and progress against the detailed performance and completion criteria;	Section 7.2
	g) identify the potential risks to the successful implementation of the biodiversity offset strategy, and include a description of the contingency measures that would be implemented to mitigate against these risks	Section 5.1, 7.5 and Appendix E and F
	h) include details of who would be responsible for monitoring, reviewing, and implementing the plan.	

Applicable Condition	Requirement	BMP Reference
		Section 9
Schedule 3, Condition 50	The Proponent shall revise the Biodiversity Management Plan within 30 months of the date of this approval, or within 6 months after the approval of Stage 2 of the Leard Forest Mining Precinct Regional Biodiversity Strategy, whichever is sooner. The revised plan must: a) be prepared in consultation with OEH, DoEE, DPI, the CCC and the North West LLS b) demonstrate consistency with any findings of Leard Forest Mining Precinct Regional Biodiversity Strategy c) include any implementation plans arising from the studies required under conditions 44 and 46 of this approval; to the satisfaction of the Secretary.	Entire BMP. Appendix F
Schedule 3, Condition 51	For the vegetated buffer corridor required to be retained and protected between the projects under Condition 7 of Schedule 2 of this approval the Proponent shall: a) use its best endeavours to work cooperatively with the Proponent of the Maules Creek Coal Project to enhance the functioning of the area as a biodiversity corridor b) include in the Biodiversity Management Plan the details as to how impacts on the corridor are to be minimised, to the satisfaction of the Secretary.	Section 6 and Appendix I

4.2.2 Biodiversity Conservation Act 2015

The *Biodiversity Conservation Act 2016* (NSW) (BC Act) came into effect on the 25 August 2017. This Act repealed the NSW *Threatened Species and Conservation Act 1995* (TSC Act), *Native Vegetation Act 2003* and parts of the *National Parks and Wildlife Act 1974*. The BC Act, similar to the TSC Act, seeks to protect certain classes of threatened wildlife including threatened species, threatened populations and threatened ecological communities.

The biodiversity reforms associated with the BC Act introduced a number of changes in regards to biodiversity offsetting including modified assessment methodologies, offset requirements and new variation rules for offsetting. In addition, the BC Act introduces the following mechanisms for ensuring long term conservation outcomes for biodiversity offsets:

- Biodiversity Conservation Fund - allows for money to be paid into a fund to offset project impacts, the costs of which are determined by the offset payments calculator

- Biodiversity Stewardship Agreement – allows landowners to enter an agreement with the Minister to establish a funded conservation outcome on private land. These agreements generate credits that may be sold to land developers and land owners who undertake development or clearing, generating a credit obligation which must be retired to offset their activity (Office of Environment & Heritage 2017).

4.2.3 Noxious Weeds Act 1993 & *Biosecurity Act 2015*

The NW Act (now repealed and replaced by the Biosecurity Act) provided mechanisms to ensure that all noxious weeds listed for the Narrabri Control Area were managed in accordance with the action set out in relation to the weeds control category. Section 10, Part 3 of the NW Act stated that occupiers of land (including owners of land) have the responsibility for controlling noxious weeds on the land they occupy. Boggabri Coal is required to ensure that all noxious weeds listed for the Narrabri Control Area are managed in accordance with the action set out in relation to the weed control category.

The Biosecurity Act came into effect on the 1 July 2017 placing the repealed NW Act. The Biosecurity Act provides mechanisms for the management of 'priority weeds' and requires occupiers of the land to control priority weeds within their declared weed control region. Boggabri Coal is required to ensure that all priority weeds listed in the North West Control Area are managed in accordance with the actions set out in relation to each weed.

A Weed and Pest Management Strategy has been developed to manage weeds within the Project Boundary and BOAs (Appendix C). Specific weed control measures for each BOA are detailed within the relevant BOA Management Plan provided as Appendix E.

4.2.4 Rural Lands Protection Act 1998

The *Rural Lands Protection Act 1998* (RLP Act) provided the mechanisms to ensure that all parties comply with pest control and eradication orders served by the Central North Livestock Health and Pest Authority (LHPA). The RLP Act has been replaced by the Biosecurity Act and pest control is now regulated by the LLS.

The Biosecurity Act specifies a number of obligations of owners and occupiers of private land, including:

- an occupier of any private land on whom a general destruction obligation in relation to a pest is imposed by a pest control order must eradicate any pest on the land by any lawful method (or, if the order specifies a method to be used, by the method specified)
- an owner or occupier of land who is served with an individual eradication order by a board must comply with the individual eradication order.

Under this Act, BCOPL has a requirement to comply with pest control and eradication orders served by the North West Branch of the LLS.

4.3 Additional standards and guidelines

The Leard Forest Regional Biodiversity Strategy Stage 2 – Strategy Report (Umwelt 2017) was developed to establish a long-term consistent framework of management, monitoring and land use security for all biodiversity conservation areas within the region, particularly those biodiversity offset areas related to open cut coal mines within and adjoining Leard State Forest.

As stated in Schedule 3, Condition 43 and 50 (Table 4.2) BCOPL has a responsibility to demonstrate consistency with the findings of the Leard Forest Regional Biodiversity Strategy. As such, the management and monitoring framework within this BMP have been aligned to those detailed in the Leard Forest Regional Biodiversity Strategy to ensure consistency with other biodiversity conservation areas within the region.

Additional publications, standards and codes of practice applicable to biodiversity management associated with the Project are listed in Table 4.3.

Table 4.3 Additional guidelines

Type	Document title	Reference
General guidelines	*Namoi Catchment Action Plan*	(Namoi Catchment Management Authority 2006)
Flora and fauna guidelines	*Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*	(Department of Environment and Conservation 2004)
	Survey and assessment guidelines for threatened birds, frogs, reptiles, bats and mammals	(Department of Environment and Climate Change 2009; Department of Environment Water Heritage and the Arts 2010a, 2010b, 2011a, 2011b)
	National Recovery Plan for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Grassy Woodland)	(Department of the Environment Water Heritage & Arts 2010)
Biodiversity offset guidelines	*A Guide to Managing Box Gum Grassy Woodlands*	(Rawlings et al. 2010a)
	Principles for the use of Biodiversity Offsets in NSW.	(Department of Environment and Climate Change 2008)
	BioBanking – A Biodiversity Offsets and Banking Scheme. Conserving	(Department of Environment and Conservation 2006)

Type	Document title	Reference
	and restoring biodiversity in NSW, working paper	
	BioBanking Assessment Methodology	(Department of Environment Climate Change and Water 2009) and (Office of Environment and Heritage 2014)
	EPBC Act Environmental Offsets Policy - Consultation Draft	(Department of Sustainability Environment Water Population and Communities 2011)
	Cost Effective Feral Animal Exclusion Fencing for Areas of High Conservation Value in Australia	(National Heritage Trust 2004)

5. Management safeguards

5.1 Contingency planning

Potential risks to the successful implementation of the BMP such as fire or flood within the Project Boundary and BOAs and contingency measures that would be implemented to mitigate against these risks are set out in this Section. Potential issues, responsibilities and management actions are provided in **Error! Reference source not found.**. Potential risks and mitigation measures associated with revegetation activities are detailed in Appendix G. Furthermore, a Trigger Action Response Plan is provided in Section 7.5 which will be used to determine whether additional actions are required to rectify any problems.

Table 5.1 Contingency plan

Issue	Responsibility	Management action
New information regarding biodiversity values (e.g. new threatened species)	Environment Superintendent	§ contact OEH and/or DoEE in the event that a threatened species previously not recorded is identified § review BMP and monitoring program, as appropriate
Chemical impacts on flora/ fauna	Environment Superintendent	§ follow reporting and communication procedures in accordance with the Incident Management Protocol (refer Section 8.2.1) § revise procedures to mitigate future risks
Unplanned clearing activity	Environment Superintendent	§ report location and extent of clearing. Collect photo evidence and provide information to relevant authorities (Police and OEH) § undertake follow up compliance checks
Fire	Environment Superintendent	§ follow reporting and communication procedures in accordance with the Incident Management Protocol § replace and maintain damaged fences and signs § exclude stock from burnt areas to allow natural regeneration. Monitor areas to identify weed control requirements
Flood	Environment Superintendent	§ follow reporting and communication procedures in accordance with the Incident Management Protocol § replace and maintain damaged fences and signs § monitor inundated areas to identify weed control requirements
Drought	Environment Superintendent	§ follow reporting and communication procedures in accordance with the Incident Management Protocol § reduce livestock grazing during times of drought § monitor the survival and growth of regenerated areas which have been direct seeded or planted with tube stock, where drought stress is identified provide

Issue	Responsibility	Management action
		a mechanism to alleviate stress such as additional watering events § prevent, control and monitor feral animals.

5.2 Conservation and Biodiversity Bond

In accordance with Condition 52 of the Project Approval, BCOPL will submit a Conservation and Biodiversity Bond that may be combined with the rehabilitation security deposit as administered by DRG (formerly NSW Trade and Investment – Division of Resources and Energy) under the NSW *Mining Act 1992.*

BCOPL will submit details of the bond and the rehabilitation security deposit to the Minister.

Alternative funding arrangements for long term management of the BOS, such as a biodiversity stewardship agreement or transfer of the BOA to conservation reserve estate may also be used by BCOPL to reduce any bond amount.

5.3 Conservation covenants

Boggabri Coal will register one or more legally binding conservation covenants over the BOAs of 8,076.8 ha of 'equivalent or better' quality of threatened species habitat defined as native vegetation communities. This will include no less than 3,065.2 ha of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community.

The conservation covenant/s will provide appropriate long-term security of the BOAs.

6. Biodiversity management within the Project boundary

6.1 Biodiversity management within the Project Boundary

The objectives for biodiversity management within the Project Boundary and a corresponding summary of management actions are detailed in Table 6.1 below.

The management actions outlined are in most cases not prescriptive, since the management of habitats and species is by its very nature a dynamic process. Management must be adaptive, recognising that the management of natural resources is often experimental, that we can learn from implemented activities, and that adaptive management is based on what has been learned. The objectives and actions are based on the precautionary principle, namely 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.

Management actions are provided for each objective. The performance criteria for management actions comprise a set of parameters measured during mine operations to demonstrate progress towards achieving the overarching completion criteria, which are linked with the Biodiversity Monitoring Program (refer Section 7.1). Following mine closure, the completion criteria will be assessed to identify whether there is a need for any ongoing management obligations.

Table 6.1 Biodiversity management within the Project Boundary

Objective	Aim	Management action

Objective 1 — rehabilitation and revegetation within the Project boundary	To rehabilitate all areas of operational activities (including active pit and emplacement area) and associated infrastructure within the Project Boundary.	§ Details of the revegetation methods to be employed within the mine disturbance area, including specific performance criteria within the disturbance area, are provided in the RMP.
		§ Disturbed areas of Leard State Forest are to be revegetated to contain vegetation communities, habitat and landforms characteristic of:
		  § Leard State Forest
		  § White Box – Yellow Box – Blakely's Red Gum Woodland EEC and CEEC
		  § Habitat for threatened species.
		§ Rehabilitation of Box Gum Woodland is to occur in accordance with the recommendations provided in the Guide to Managing Box Gum Grassy Woodlands (Rawlings et al. 2010b) and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland National Recovery Plan (Department of Environment Climate Change and Water 2011).
		§ Where possible, mine rehabilitation areas are to provide habitat connectivity within the locality between existing native vegetation to provide best possible habitat linkages across the wider regional landscape.

Objective 2 — habitat augmentation and nest box installation	To supplement habitats identified as having low habitat resources	§ Habitat augmentation, using salvaged resources or nest boxes, should be undertaken in habitats identified as having low habitat resources (i.e. mine rehabilitation).
		§ Where nest boxes are to be installed:
		  § They are to be made of high quality and durable material
		  § They are designed to target hollow-dependent threatened species known to occur in the Project locality (i.e. woodland birds, microchiropteran bats and arboreal mammals).
		§ The total number of hollows in the mine rehabilitation area should be at least the same as the number of hollows with signs of use (nesting material, feathers, fur scratches, etcetera) removed from the Project impact site.
		§ Nest box installation would be staged over time to mirror the regeneration of the woodland.

Objective 3 — maximising salvage and beneficial use of resources	To develop habitat for native fauna in the rehabilitation areas through the reuse of important habitat features salvaged from the clearing areas.	§ Habitat resources, such as fallen timber, hollow logs and bush rock, would be salvaged within approved disturbance areas for re-use in the mine rehabilitation area and restoration zones of biodiversity offset areas. § Collection of fauna habitat resource data to be undertaken during the pre-clearing surveys. Data for each habitat type is collected in accordance with Clearing Extent and Site Feature Checklist form in Appendix B (Clearing and Fauna Management Procedure). § For woody debris, the linear length of fallen timber within fauna habitat types for each clearing lot will be estimated. The average of all the fauna habitat types will be calculated. This figure will then be halved and used as the salvage target for that year's clearing works. The salvage target will

Objective	Aim	Management action
		change from year to year due to the habitat types and the area to be cleared. The amount of salvageable material collected will be dependent on the resources structural integrity. § For bush rocks, the same procedure but measurements will be taken in m^2. § Undertake the relocation of habitat resources in accordance with the Clearing and Fauna Management Procedure (Appendix B) and Soil Management Protocol (Appendix I). § Take photographic records of salvage operations and maintain relevant documentation. § The GPS co-ordinates for each salvage piles are to be recorded for ease of relocation after clearing works have been completed.
Objective 4 — conserving and reusing topsoil and subsoils	To conserve, store and reuse topsoil and subsoil in an appropriate manner.	§ Details of the conservation and reuse of topsoils and subsoils to be employed within the mine disturbance area including specific performance criteria is provided in the Soil Management Protocol (Appendix I) and the RMP A key management action for conserving, storing and reusing topsoil and subsoil includes the development of a Soil Stripping and Placement Plan developed for each to be stripped.
Objective 5 — protecting vegetation and soil outside the disturbance areas (minimising disturbance)	To protect vegetation and soil by restricting the impact of vegetation clearing and soil disturbance to those areas necessary for the Project.	§ Ensure vegetation clearing is undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B). § Restrict vegetation clearing and soil stripping to the areas approved by the development consent.
Objective 6 — investigate the development of a translocation and or propagation plan for *Tylophora linerais*	To investigate development of a translocation and or propagation plan for the threatened flora species *Tylophora linerais*. The investigation will determine the particular requirements for the species and likelihood of translocation success following the findings of the initial Translocation of the species by Maules Creek Coal Mine.	§ Consult with DP&E on the requirements for translocation and or propagation plan for this species design mining landforms to avoid concentration of flow and reliance only structural drainage and erosion controls. § Consult with Maule Creek Coal Mine on the findings and progress of the Maule creek Translocation and or Propagation Plan for *Tylophora linearis*.
Objective 7 — managing the impacts of salinity on biodiversity	To prevent salinity of soils and water from impacting on local biodiversity.	§ Conduct soil and inter/over burden testing for PAF, salinity and sodicity throughout rehabilitation areas. § Conduct water monitoring of storage, discharge and receiving environments to monitor and assess impacts and proposed mitigation strategies on reducing salinity levels. § Retain vegetation where practicable to improve site drainage. § Minimise disturbance or exposure of soils (outside of that necessary for mining) in areas identified as having a high salinity risk.

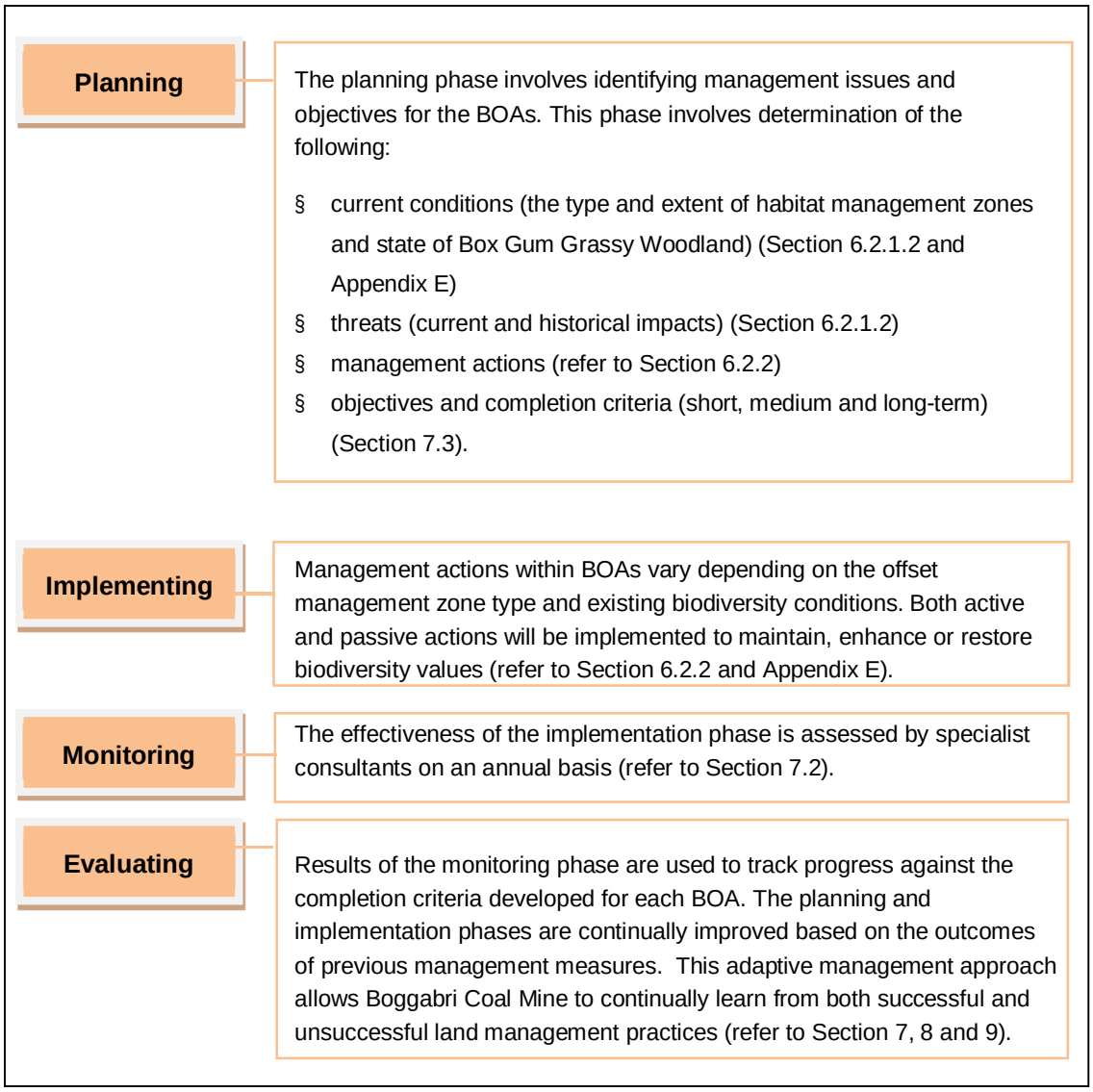
Objective	Aim	Management action
Objective 8 — pre-clearing surveys	To identify and manage threatened flora within the clearing footprint and reduce the impacts of clearing on native fauna through relocation. The Clearing and Fauna Management Procedure (Appendix B) outlines the proposed clearing methods including pre-clearing surveys.	§ Ensure vegetation clearing is undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B), including the requirements for the Project Ecologist to complete pre-clearing relocation of fauna where required and pre-clearing surveys.
Objective 9 — managing impacts on native fauna	To avoid and minimise the Project's impact on native fauna and to maintain or improve the condition of retained habitat for fauna.	§ Ensure vegetation clearing is undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B), including implementation of the following measures: § staged clearing approach (including a 48 hr break between Stages 1 and 2) § pre-clearing relocation where required § pre-clearing and post-felling surveys § salvage of habitat resources.
Objective 10 — collecting and propagating seed	To ensure the genetic diversity in species found in the Brigalow Belt South is maintained through seed collection and propagation.	§ Collect native seed for the establishment of native vegetation, in accordance with the RMP and Florabank Guidelines (FloraBank 2018). § If sufficient seed resources are available, undertake seed collection in the local area. § Collect seed from the three broad native vegetation classes (native grasslands, grassy woodland on fertile soils and shrubby woodlands/ open forest on skeletal soils) including the threatened Box Gum Grassy Woodland community. § Collect seed from a wide variety of species present in each vegetation class. § Ensure that plants are propagated and raised in a nursery.
Objective 11 — controlling weeds and feral animal species	To decrease the extent of weed and feral animal populations within the Project Boundary and adjoining land to align with benchmark conditions observed in analogue sites.	§ The operations will comply with the Weed and Pest Management Strategy (Appendix C). § Monitor weed and pest densities within land adjoining the Project Boundary and where possible, work with land managers to complete control events. § Observations of noxious and/or priority weeds will be reported to the BCOPL Environment Superintendent. § Control noxious and priority weeds in accordance with the actions set out in relation to the relevant weed control category or noxious weeds notice. § Comply with pest control orders, pest eradication orders or other requests with regard to pest control from the North West branch of the LLS. § Recommendations outlined in the Department of Primary Industries Vertebrate Pesticide Manual (NSW Department of Primary Industries 2018) would be considered for pest animal control. § Communicate weed management and pest control measure issues to other coal mines, land owners and stakeholders as required to ensure integrated approach to management (Natural Resources Commission 2014a).

Objective	Aim	Management action
Objective 12 — managing grazing and agriculture	To appropriately manage grazing within the rehabilitation areas, BOAs where appropriate, mine infrastructure area/haul route and rail spur where the final land use will incorporate a mixture of land capability Classes III, IV and V for grazing pasture.	§ Exclude livestock from rehabilitation areas in the mine disturbance area. § Restrict livestock grazing to designated grazing lands and areas deemed suitable for crash grazing for weed management where appropriate. § Monitor grazing pressure associated with live-stock and native species as part of the Biodiversity Monitoring Program.
Objective 13— controlling access	To prevent unauthorised access to rehabilitation areas through the provision of designated access roads and signage.	§ Maintain signs throughout Leard State Forest to advise forest users not to enter the Project Boundary. § Maintain access roads and tracks within the Project Boundary.
Objective 13 — minimising impacts to biodiversity, including threatened species	To minimise impacts to biodiversity, particularly threatened species.	§ Ensure that Project operations comply with the Weed and Pest Management Strategy (Appendix C). § Ensure vegetation clearing is undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B). § In the event that threatened species that have not been previously recorded within the project boundary are identified, consult OEH and/or DoEE regarding the potential for relocation/translocation or other mitigation/management measures.
Objective 15 — bushfire management	To minimise the risk of inappropriate fire regimes which may adversely affect biodiversity. Details regarding bushfire management are provided in the Public Safety EMP. An overview of the management strategies and performance criteria is provided below.	§ Monitor and maintain equipment and areas where bushfire hazards are present to prevent and minimise the potential outbreak of bushfire. § Ensure highly flammable materials (such as fuels, oils and other flammable chemicals) are stored in accordance with the Australian Standards. § In the event that the BCOPL Environmental Superintendent identifies a significant fire risk within the Project Boundary, complete a fuel load assessment and if applicable, assess the feasibility of completing fuel load reduction burning, and or fire breaks or introducing a temporary grazing regime to reduce fuel loads.
Objective 16 — protecting a vegetated corridor between the Project and the Maules Creek Coal Project	To retain and protect a vegetated east west buffer corridor of 250 metres within the Boggabri Coal Mine Project Boundary.	§ Consult representatives of the Maules Creek Coal Mine regarding maintaining an appropriate vegetated buffer and discuss clearing limits to ensure an appropriate vegetated buffer is maintained. § Prioritise weed and pest control measures within the vegetative corridor in order to manage edge effects. § Consult Maules Creek regarding weed management and pest control measures, habitat augmentation, fencing, signage and ecological monitoring associated with the vegetation corridor. § Develop and implement a Biodiversity Corridor Plan. § Clearing boundaries in proximity to the vegetation corridor are to be clearly delineated and no stockpiling or storage of plant to occur beyond each 5, 10 15 and 21 progressive disturbance limits, as appropriate.

Objective	Aim	Management action
Objective 17 — an integrated approach to biodiversity management	To achieve the overarching biodiversity management objectives for the Project through the integration of the RMP and BMP.	§ The management measures provided in the RMP and BMP are consistent and allow an integrated approach to biodiversity management. § Where feasible develop strategies to cover both the Project Boundary and BOAs (e.g. the Weed and Pest Management Strategy (Appendix C).
Objective 18 — limiting vegetation clearing	To specify the maximum project area disturbance (in hectares) for each of the years 5, 10, 15 and 21 to Box Gum Woodland threatened ecological community and habitat or potential habitat for the Regent Honeyeater, Swift Parrot and Corben's Long-eared Bat.	§ BCOPL demonstrates collaboration with the person taking the action to develop management strategies to comply with the Maules Creek Coal Project EPBC Act approval (EPBC 2010/5566), in order to minimise progressive project area disturbance limits across both sites.
Objective 19 — erosion control	To control erosion and sediment within the Project Boundary that will impact upon biodiversity. These controls will include measures currently undertaken in accordance with the Surface Water Management Plan (SWMP) for the Project.	§ The erosion control measures within the BOAs will be used as outlined in the SWMP. § The erosion control measures within the Project Boundary are considered and implemented if required as described in Section 4.4.1 of the SWMP. § Monitor and inspect the erosion controls within the Project Boundary. § Observations of non-functioning erosion and sediment controls are reported to the BCOPL Environment Superintendent. § Erosion control measures are reported in the Annual Review where applicable.
Objective 20 — potential cultural heritage values conflicts	To control any potential conflicts that may occur between the Mine Rehabilitation area in the Project Boundary and cultural heritage values. These controls will include measures currently undertaken in accordance with the Cultural Heritage Management Plan and the Aboriginal Heritage Conservation Strategy for the Boggabri Coal Mine.	§ Archaeological artefact, once confirmed by heritage specialist are to be managed in accordance within the process and due diligence guidelines presented in the CHMP.
Objective 21— restoration of understorey clearing outside the mine disturbance limit	To allow natural regeneration of area cleared of understorey vegetation outside the mine disturbance limit in February 2014.	§ No vegetation clearing to occur within the disturbed area. § Monitoring of disturbed area to occur annually to determine whether natural regeneration of understorey is occurring. § Assisted natural regeneration to occur should disturbed area not met performance and completion criteria as detailed in Table 7.6.

6.2 Implementation of the Biodiversity Offset Strategy

The process for managing BOAs has been developed from the Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a). This process involves four key phases (Inset 2) and is successive from the commencement of the management program, with each phase implemented continually until achievement of the relevant completion criteria (Section 7.3).



Inset 2 Overview of the offset management process

The Planning and Implementing phases of the BOS are detailed in Sections 6.2.1 and 6.2.2. The Biodiversity Monitoring Program is provided in Section 7.2 whilst measures associated with the evaluating phase are outlined in Section 7.4 and 7.5.

6.2.1 Planning

The planning phase involves the development of site specific objectives/completion criteria and gathering of information to guide the implementation of appropriate management measures.

Subsequent to preliminary field surveys and assessments, ecologists from Parsons Brinckerhoff completed inspections of each BOA between 13 - 17 August 2012 and March to April 2015, to specifically identify current condition and management actions for inclusion in this BMP. Specific details and measures are provided for each BOA in Appendix E.

Completion criteria have been developed for the BOAs (Section 7.3). The criteria are directly linked to BBAM 2014 benchmarks and analogue sites from Leard State Forest sampled as part of the Biodiversity Monitoring Program (refer Section 7.1.1). In order to demonstrate achievement of the completion criteria, specific environmental indicators (e.g. foliage cover) have been set out in the below in Section 7.3.

When developing implementation measures for biodiversity management identifying the condition of the subject site and the existing disturbances affecting or threatening environmental health is important. The following sections detail the process of identifying existing conditions and summarise the disturbances known to be impacting on the BOAs.

6.2.1.1 Existing management condition of BOAs

Four distinct management zones are recognised within the BOAs. These zones are classified according to environmental condition and the distinct suite of management measures required maintaining, enhancing or restoring biodiversity values within these areas.

A brief description of each management zone is provided in the following sections and a breakdown of the extent of each zone within the BOAs is provided in Table 6.2 and illustrated in Figure 6.1.

Habitat management zone

The habitat management zone is associated with remnant native woodland vegetation in good condition, with limited disturbances and exotic species present. This zone requires some active pest and weed management activities, fencing of areas adjoining lands not managed for biodiversity conservation and the exclusion of livestock grazing. These areas are generally considered to not require any assisted revegetation and provide existing high quality fauna habitats.

Habitat restoration zone

The habitat restoration zone incorporates those areas of good condition native grassland communities with only moderate exotic species present and an existing soil seed bank with the potential for natural revegetation.

Management activities within this zone involve fencing, targeted pest and weed management and supplementary canopy planting to facilitate enhanced revegetation of the canopy layer. This zone will also incorporate the provision of supplementary habitat features to further encourage use by local fauna species.

Corridor enhancement zone

The corridor enhancement zone incorporates those areas of non-native grasslands that have been significantly disturbed by past land use practices, including clearing, cropping, pasture improvement and heavy grazing. This zone incorporates supplementary canopy planting and some targeted weed and pest management activities to increase woody canopy cover and build on adjoining existing wildlife corridors. This zone is likely to further encourage the use of the proposed wildlife corridors by semi mobile fauna species in the medium to long-term.

Other lands for agriculture zone

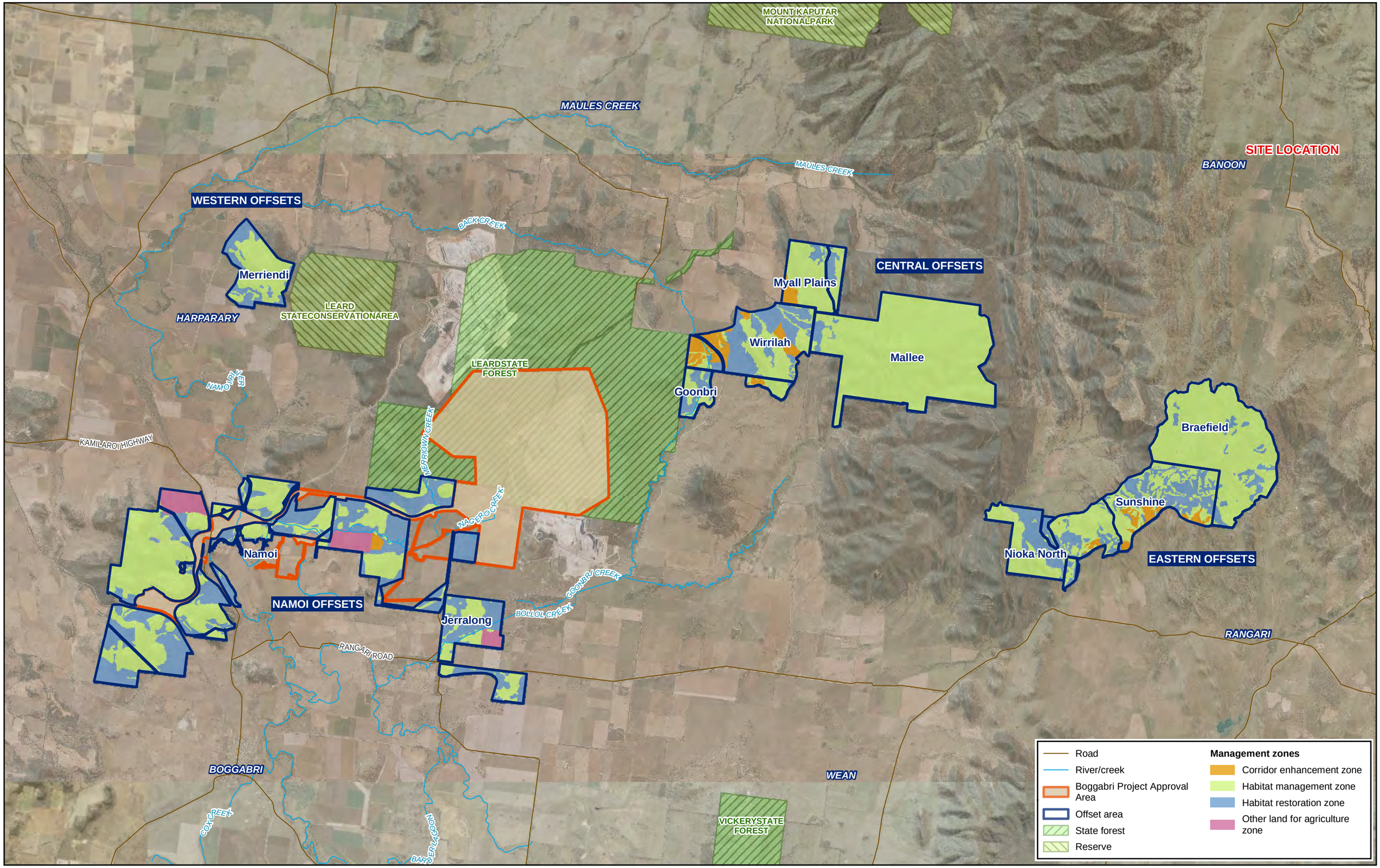
The other lands for agriculture zone incorporates highly productive agricultural land previously identified as containing pasture improvement, cropping or other intensive agricultural activities. These areas are considered to provide only limited potential for revegetation and are not considered critical to the establishment of the proposed wildlife corridors or habitat areas within the BOAs.

Table 6.2 Extent of offset management zones within each BOA

BOA	Management zones (ha)				Total
	Habitat Management	Habitat Restoration	Corridor Enhancement	Other Lands for Agricultural	
Eastern Offsets					
Braefield	1,283.2	117.1	0.4	0	1,400.7
Sunshine	353.2	300.1	84.7	0	738.0
Nioka North	523.1	316.6	17.9	0	857.6
Eastern Offsets Total	**2,159.5**	**733.8**	**103.0**	**0**	**2,996.3**
Central Offsets					
Mallee	2,025.9	40.3	0	0	2,066.2
Myall Plains	367.4	62.0	43.9	0	473.3
Wirrilah	326.8	371.8	185.6	0	884.2
Goonbri	127.6	88.3	15.1	0	231.0
Central Offsets Total	**2,847.7**	**562.4**	**244.6**	**0**	**3,654.7**

BOA	Management zones (ha)				Total
	Habitat Management	Habitat Restoration	Corridor Enhancement	Other Lands for Agricultural	
Namoi Offsets					
Namoi[1]	1,563.4	1,391.4	30.3	229.8	3,214.9
Jerralong	222.4	300.8	0	46.9	570.1
Namoi Offsets Total	**1,785.8**	**1,692.2**	**30.3**	**276.7**	**3,785.0**
Western Offsets					
Merriendi	327.0	156.2	0	0	483.2
Combined OffsetsTotal	**7,120.0**	**3,144.6**	**377.9**	**276.7**	**10,919.2**

(1) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine). The Namoi BOA as discussed in this BMP, totalling 3,214.9 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.



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Projection: Transverse Mercator
Coordinate System: GDA 1994 MCA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018); Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri

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FIGURE 6.1

TITLE. MANAGEMENT ZONES WITHIN THE BOA

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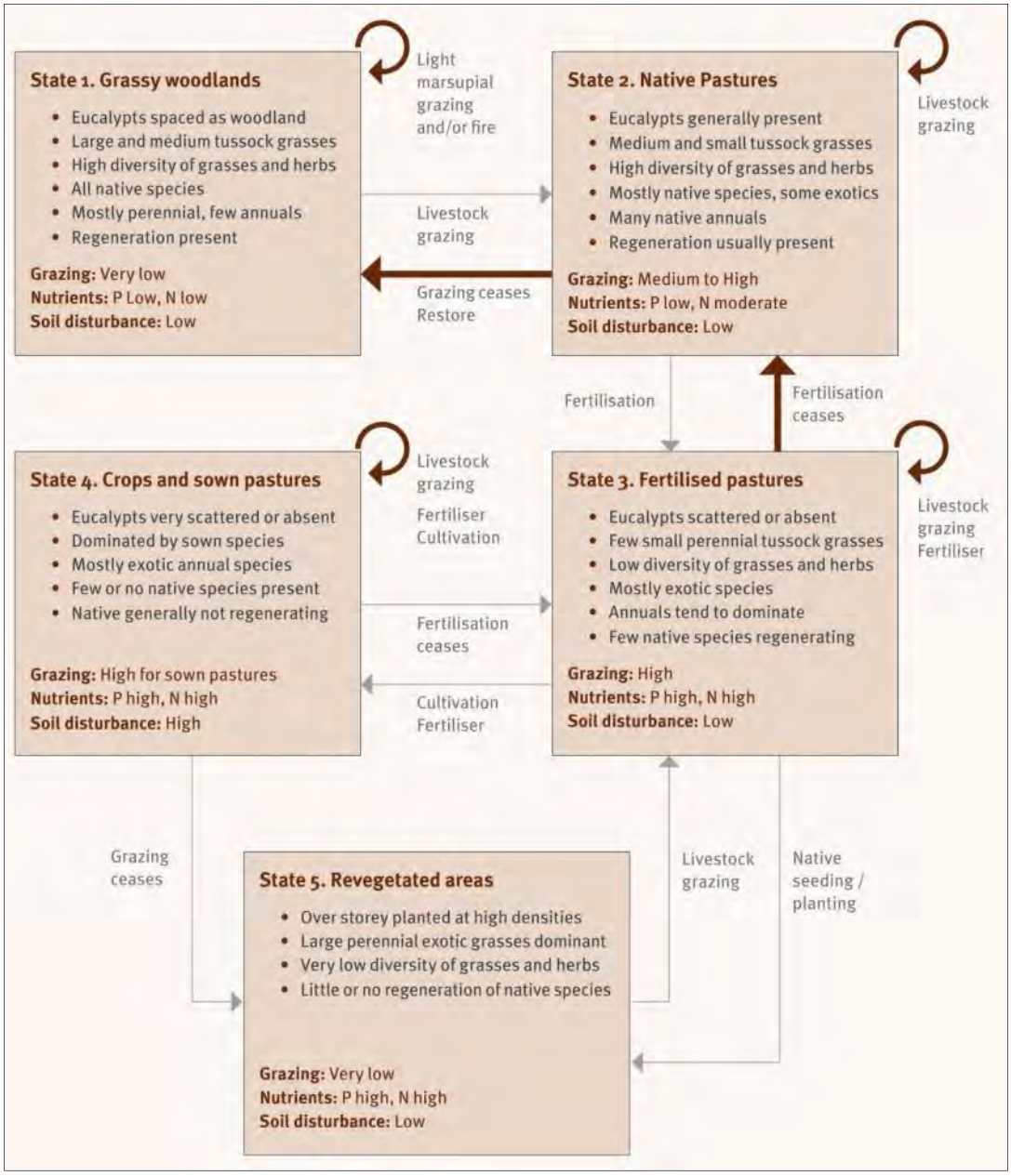
6.2.1.2 Box Gum Grassy Woodland

Areas of the Box Gum Grassy Woodland community within each offset management zone have been further classified in accordance with the State and Transition Model provided in the Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a) (Inset 3).



Inset 3 Box Gum Grassy Woodland State and Transition Model (Rawlings et al. 2010)

The State and Transition Model identifies the drivers for change between the five recognised states of Box Gum Grassy Woodland. The BOAs contain Box Gum Grassy Woodland ranging in condition between States 1 and 5. While the transition of all areas to State 1 is not a realistic objective in the short to medium term, the management measures are focused on progressing each patch to the succeeding level of environmental health i.e. Stage 3 - fertilised pasture to Stage 2 - native pasture.

The BOAs contain approximately 3,487.6 ha of Box Gum Woodland which is listed under the BC Act and/or EPBC Act listed White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands. A summary of the Box Gum Woodland across the BOAs is provided below in Table 6.3 and illustrated in Figure 6.2.

Table 6.3 Summary of Box Gum Woodland EEC within the BOAs

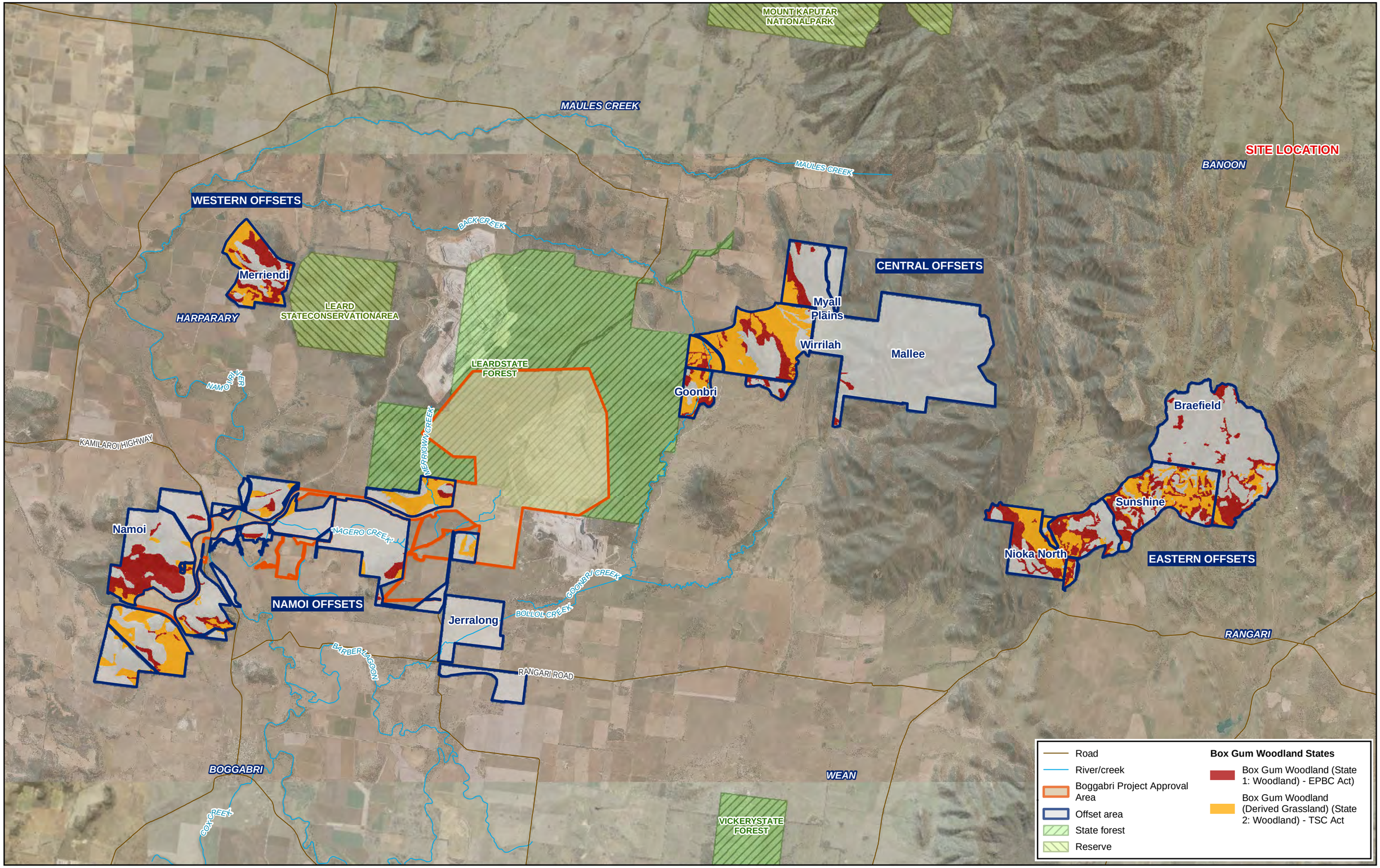
Biodiversity Offset Area	State of Box Gum Woodland	
	State 1 – Woodland (ha)	State 2 – Native pastures (ha)
Merriendi	176.1	150.5
Namoi	326.4	590.1
Jerralong	0	0
Goonbri	72.3	88.3
Wirrilah	146.1	517.5
Myall Plains	66.5	43.9
Mallee	14.2	0
Nioka North	291.5	265.2
Sunshine	240.5	248.8
Braefield	194.3	55.4
Total	1,527.9	1,959.7

The general relationship between the condition class of Box Gum Grassy Woodland and each offset management zone is defined in Table 6.4. All areas of 'native pastures' will be restored back to 'woodlands' as required by Condition 39 of the projects approvals.

Table 6.4 Offset management zones corresponding with Box Gum Grassy Woodland condition classes

Offset management zone	Box Gum Grassy Woodland condition class[1]
Habitat management zone	State 1 and State 2 woodland
Habitat restoration zone	State 2 native pastures
Corridor enhancement zone	States 3 and 5
Other lands and agriculture zone	State 4

Note: Sourced from 'A Guide to Managing Box Gum Grassy Woodlands' (Rawlings et al. 2010a)



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Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018); Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri

IDEMITSU BOGGABRI COAL

MINE NAME.	2171706A_GIS_BMP022_A1
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	4/09/2018

FIGURE 6.2

TITLE. BOX GUM WOODLAND EEC WITHIN THE BOGGABRI OFFSET AREAS

DRAWING. \\corp.pbwan.net\ANZ\SectionData\Environment\EPSE\ECOLOGY\Z_boggabri\GIS\5_Shared_GIS\54_Production\Maps\Environment\BMP\2171706A_GIS_BMP022_A1.mxd

6.2.1.3 Impacts and threats

Appropriate management measures have been identified for each BOA (Appendix E). These actions have been developed with reference to the historical drivers of transition and current processes impacting upon or threatening biodiversity values within each site. Disturbances known to be threatening the BOAs include:

- clearing and fragmentation
- livestock grazing
- nutrient enrichment
- weedy exotic plants and pest animals
- inappropriate fire regimes
- alteration of abiotic factors (hydrology, nutrients and soil)
- pesticides and herbicides
- firewood collection.

The type and extent of disturbances vary between the four offset management zones within each BOA, for example land within the habitat management zone is likely to be subjected to fewer disturbances than land within the habitat restoration zone.

6.2.2 Implementing biodiversity management within the BOAs

The management of BOAs requires a combination of both passive (e.g. retaining fallen timber) and active (e.g. revegetation) measures. The type and extent of management measures required differ between the offset management zones as described in Table 6.5.

Table 6.5 Management measures associated with each offset management zone

Management measure	Offset management zone		
	Habitat management zone (maintenance)	Habitat restoration zone (enhancement)	Corridor enhancement zone (restoration)
Fencing[1]	●	●	●
Grazing management for conservation		●	●
Weed and pest control	●	●	●
Fire management for conservation[2]	●	●	●
Management of human access and disturbance	●	●	●
Retention or addition of habitat features	●	●	●
Nutrient control		●	●
Erosion control		●	●
Thinning (Pine and Native Shrub)	●	●	●
Natural regeneration	●	●	●
Active revegetation		●	●

1. The existing and proposed fences may include areas that do not line up exactly with zones but each of the zones will be protected.
2. The use of fire is subject to approval from the relevant state authorities (e.g. NSW Rural Fire Service) (refer Section 0).

Management measures associated with the maintenance, enhancement and restoration of BOAs are described in the following sections. These measures have been adapted from a range of guidelines and literature, particularly the Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a).

Specific measures for each BOA are provided in separate management plans, provided as Appendix E.

6.2.2.1 Maintenance and enhancement

Access control for the protection of existing habitats

Permanent fencing will be used within BOAs to exclude livestock from areas managed for biodiversity conservation, including habitat management zones and habitat restoration zones.

The siting and design of livestock exclusion fencing will consider potential risks to native wildlife, particularly temporary electric fences, which have the greatest potential to injure and kill native species.

Overarching management controls employed across all BOAs include:

- where BOAs share common boundaries, fencing designs should not restrict native fauna movement or connectivity between habitats
- fences along BOAs common boundaries being managed in the same way should be investigated to determine whether unnecessary fences could be removed/avoided
- where possible, any fencing along waterways will be installed a minimum of 10 m from the top edge of the bank
- where required, fences will include a gate to manage access
- the bottom strand of any electric fences will not be electrified and barbed-wire should be avoided where possible
- consideration will be given to avoiding or minimising clearing of native vegetation when installing new fences where none currently exist
- fencing will be implemented in a staged approach to control livestock.

Grazing management for conservation

Poorly managed livestock grazing can cause significant damage to patches of remnant vegetation and restoration areas; however, if managed appropriately grazing can be used as an effective tool to control weeds, manage bushfire risks, reduce biomass and positively manipulate species composition and vegetative structure. As such boundary fencing of all BOAs will be upgraded as required to exclude unauthorised stock grazing.

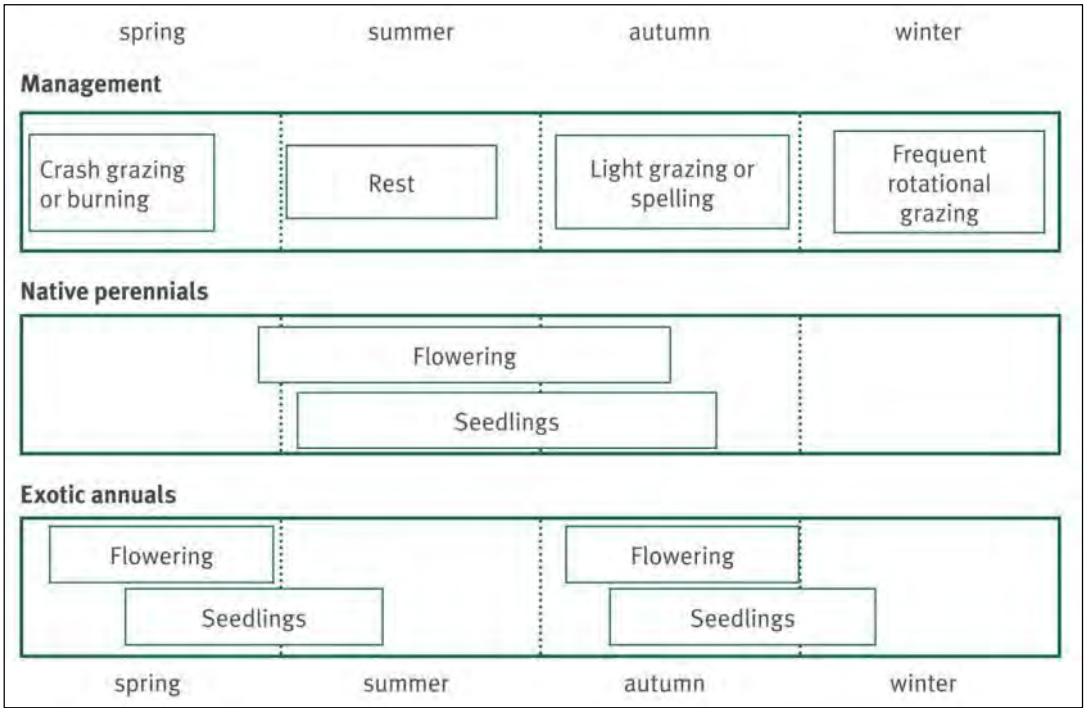
Livestock grazing will be permanently excluded from habitat management zones. Livestock will initially be excluded from habitat restoration zones and corridor enhancement zones. Following the establishment of plantings within these areas, an investigation into sustainable livestock carrying capacities will be undertaken to assess the feasibility of introducing a strategic livestock regime.

The exclusion of livestock or alteration of grazing regimes can lead to positive or negative outcomes. Unintended and negative outcomes will be identified during annual inspections undertaken within the BOAs and as part of the Biodiversity Monitoring Program (refer Section 7).

In the event that a grazing regime is deemed feasible within the habitat restoration zones and corridor enhancement zones, the following overarching management controls will be employed as required:

- crash and seasonal grazing may be used in habitat restoration zones and corridor enhancement zones to control weed species and encourage native species diversity
- crash grazing using cattle is likely to be undertaken between late autumn and mid spring before weeds go to seed and while palatability and nutrient content is still high. Crash grazing would be restricted to small, temporarily fenced areas by allowing large numbers of livestock to graze for very short periods, generally until plants are grazed to a height between 5 -10 cm
- the timing of grazing would be appropriate to targeted weeds and native species (Inset 4). Only limited grazing will be undertaken during summer, allowing native grasses to seed and regain dominance
- the timing of grazing regime would also be critical for use in reduction of fuel loads in BOAs. The use of grazing for reduction in fuel loads would only be used when it has been assessed that the fuel load is extreme within the BOAs.

Inset 4 provides an example of a seasonal grazing strategy aimed at controlling annual weeds.



Inset 4 Seasonal grazing strategy (Rawlings et al. 2010)

Weed and pest control

Weed and pest control measures within the BOAs will be undertaken in accordance with the Weed and Pest Management Strategy (Appendix C) and the control schedules developed for each BOA (Appendix E). Weed density mapping provided in each BOA Management Plan (Appendix E) may be updated as part of the annual BMP review. Overarching management controls employed across all BOAs include:

- weed management and pest control trends to be communicated to other coal mines (BMT Complex) in the locality and include:

- 4 review of Weed and Pest Management Strategy (Appendix C) and BMP for current information and updates on weeds and pests
- 4 discussion and prioritisation of weed and pest prevention, control measures and targets species across the BMT Complex for the following year
- 4 liaise with local land managers and stakeholders regarding control measures and schedules.

- BMT complex to be alerted of any new or emerging weed and/or pest species recorded on any of the BOAs, where identified
- an integrated weed management and pest control approach may be implemented across the BOAs to allow for a consist reporting and analysis
- weed management may comprise of a combination of nutrient management, physical removal and herbicide application. Crash grazing may also be used in habitat restoration zones and corridor enhancement zones weeds along creeks and drainage lines will be controlled in a staged approach
- weed control methods may be targeted to specific species and the condition of the subject site. Methods may include physical and mechanical controls such as hand-pulling, chipping, slashing and where necessary, use of machinery. Methods of herbicide application will include spray-topping, the cut and paint method, stem injection and spot spraying
- Significant weed infestations or establishment of new weed species within BOAs to be reviewed and control measures implemented within 1 year of identification
- pest control strategies may include the destruction of burrows, shooting, trapping and baiting in accordance with NSW Codes of Practise and Standard Operating Procedures as outlined in Appendix C
- public communication on pest animal records may be reported through Feral Scan as outlined in Appendix C
- Significant pest occurrences or newly identified pest species within BOAs to be reviewed and control measures implemented within 1 year of identification.

Management of fuel loads and implementation of appropriate fire regime for conservation

Fire management is an important tool for biomass control, nutrient management and positive species manipulation, through stimulation of seed germination. Developing an appropriate fire regime is difficult, as a lack of fire (or a disturbance that mimics fire) can lead to denser canopies and less diversity in the groundcover and mid-storey layers, while excessive burning can adversely affect soil surface conditions resulting in compaction, crusting, poor infiltration, decreased biological activity which results in a decreased biodiversity of native species (Rawlings *et al.* 2010b).

The implementation of a fire regime within the BOAs is subject to approval from relevant authorities. As an alternative to using fire, biomass control, nutrient management and positive species manipulation may be managed though a seasonal grazing strategy within habitat restoration zones and corridor enhancement zones.

The following overarching management controls relate to the implementation of fire regimes within all BOAs:

- Fuel load assessment will be undertaken as part of annual BOA inspections to determine whether a fuel reduction burn is required based on a risk basis or as recommended by the NSW Rural Fire Service
- in the event a fuel load assessment indicates extreme fuel loads which pose significant fire risks within the BOAs, BCOPL will consider trialling strategic crash grazing, introduction of fire breaks and/or strategic hazard reduction burns to reduce fuel loads
- control burns should aim to reduce impacts on biodiversity by undertaking burns in autumn and avoid burning trees which contain hollow resources, where possible, to encourage native species recruitment and minimise impacts on roosting and nesting availability
- control burns should consider recommendations outlined in Section 9 of Guide to Managing Box Gum Grassy Woodlands (Rawlings *et al.* 2010b)
- maintenance of existing access tracks and fire breaks within the BOAs in accordance with the LLS Act, BC Act or *Rural Fires Act 1997* would be continued to control any inappropriate fire regimes
- relevant permits and approvals will be sourced from the NSW Rural Fire Service before BCOPL proceeds with a hazard reduction burn
- where practical mosaic burning will be implemented to reduce the extent of any negative outcomes, provide refuge for wildlife and promote structural and species diversity
- the fire regime may use 'hot fires' to stimulate regeneration from the soil seed bank or 'cool fires' to control established weeds
- the timing of burning will be site specific; however, it will generally be undertaken in autumn to encourage native species recruitment. Controlled burning may also be undertaken in spring to reduce the seed set of exotic annuals
- the frequency of fire events (average) will range between four and eight years, however the interval between fires may be less than four years, depending on the site-specific objectives.

Management of human access and disturbance

Unauthorised access to the BOAs has the potential to inhibit the success of management activities, particularly through the introduction and spread of weed and pest species. Weed and pest infestations may also be promoted by surrounding land use activities, which can increase edge effects.

Specific measures to control access and limit disturbance associated with adjoining land uses have been developed for each BOA (Appendix E). Overarching management controls employed across all BOAs include:

- access gates will be locked and key distribution controlled by the Environment Superintendent (or an alternate nominated BCOPL representative)

- where possible, existing access tracks within each BOA will be maintained to allow access for monitoring events and potential fire control.

Salvage of habitat resources and provision of artificial/supplementary habitat

Habitat features, such as fallen timber provide significant habitat for a range of native fauna species and reduce the risk of soil erosion. The Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a) indicates that healthy Box Gum Grassy Woodland communities generally contain at least four to ten cubic metres of fallen timber per hectare.

Habitat features will be retained within all offset management zones and BOAs. The addition of habitat features in BOAs will be undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B). Habitat resources relocated to BOAs will include fallen timber and natural hollows. BCOPL will trial the relocation of hollow-bearing trees (stags) into rehabilitation areas to assess the feasibility of this practice (Appendix B).

In addition to the retention of habitat resources and recycling of products of clearing such as fallen timber and natural hollows, BCOPL will develop a nest box procedure for each offset area (Eastern, Central, Namoi and Western) five years following commencement of active revegetation. The procedure is integrated into each BOA Management Plan (Appendix E) and identifies the target quantities, types and provides a protocol for installation, maintenance and monitoring.

Specific measures regarding the retention and addition of habitat features have been developed for each BOA (Appendix E). Overarching management controls employed across all BOAs include:

- habitat features will only be sourced from areas cleared for mine development or where approved thinning has occurred. Habitat features for consideration when salvaging should include one or more of the following where available and of suitable structural integrity:
    - fallen timber
    - arboreal hollows
    - hollow logs
    - bush rock.
- the addition of habitat features will only occur in habitats identified as having low habitat resources (i.e. land classified as a habitat restoration zone or corridor enhancement zone)
- where possible, habitat features will be placed perpendicular to the flow of water, sediments and nutrients to capture on site resources. Additionally, habitat features may be placed to provide refuge islands within large areas of open space
- A nest box procedure will be prepared for each offset area (Eastern, Central, Namoi and Western) five years following commencement of active revegetation.
- The total number of hollows (existing hollows and nest boxes combined) at each offset area (Eastern, Central, Namoi and Western offsets) will be at least the same as the

number of hollows with signs of use (nesting material, feathers, fur, scratches, etcetera) and of suitable dimensions for species occupancy removed from the Project impact site.

- nest boxes installed must be of high quality and made with durable materials and designed to target hollow-dependent threatened species known to occur in the Project locality (i.e. woodland birds, arboreal mammals and microchiropteran bats)
- nest box installation is to be staged over time to reflect the regeneration of the woodland.

Nutrient control

The addition of soil nutrients, such as phosphorus and nitrogen promotes weed growth and inhibits the development of native plants, which have adapted to cope in relatively low nutrient environments.

Nutrient management may be undertaken by physically removing nutrients from a site (crash grazing, hay cutting, topsoil removal (scalping)) or by employing methods (burning, seeding, carbohydrate addition) to lock nutrients in preferred vegetation, such as Kangaroo Grass (*Themeda australis*). Considerations will also be made to reducing or eliminating fertiliser use in adjacent or upslope paddocks and creation of buffers to capture nutrients before they enter areas of native vegetation or water bodies, wherever practicable.

Nutrient control within BOAs will be managed through weed control (physical and chemical), revegetation and in some instances grazing management (i.e. restricted and controlled stock crash grazing where applicable) and controlled burning.

Erosion control

Soil erosion will be managed within BOAs by restricting livestock access and through the implementation of revegetation activities, pest control, appropriate placement of habitat features and development of specific erosion control measures in high risk or severely affected areas. Erosion control measures employed within the BOAs may include:

- interceptor banks
- sediment fences
- gabions
- drain and bank stabilisation using geofabrics
- mulching.

Specific measures regarding erosion control have been developed for each BOA. (Appendix E).

Pine Thinning

Areas within the BOAs have been identified as containing dense patches of regrowth native White Cypress Pine (*Callitris glaucophylla*). These patches are characterised by a bare understorey, with the recruitment of other native species inhibited by shading and the layering of pine needles. In addition to inhibiting the recruitment of native species, pine monocultures limit food and habitat resources for native fauna and increase surface water run-off and erosion.

The Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a) indicates that healthy Box Gum Grassy Woodland communities generally contain approximately 30 mature trees per hectare.

Specific measures regarding pine and native shrub thinning have been developed for each BOA (Appendix E) generally in accordance with the 'Actively Managing for Better Ecological Outcomes for the Brigalow and Nandewar State Conservation Area' (Natural Resources Commission 2014a). Overarching management controls employed across all BOAs may include:

- investigation into most appropriate management method prior to undertaking works including:
  - prescribed burns (early cypress regrowth)
  - ecological thinning (more advanced regrowth)
  - targeted grazing in certain circumstances (refer Section 8.4 of the Actively Managing for Better Ecological Outcomes for the Brigalow and Nandewar State Conservation Areas (Natural Resources Commission 2014b),
- where possible, thinning will retain mosaic patches of approximately 400 stems per hectare (approximately 5x5 m spacing) of small trees (<10 cm diameter at breast height (DBH))
- cleared material will be spread around the subject site to minimise weed establishment or used elsewhere as required
- areas subject to thinning will be regularly inspected to identify the establishment of any weed species and the requirements for active revegetation
- as required, using machinery to thin some patches of regrowth White Cypress Pine in the BOAs.

Native Woody Weed Thinning

Areas within the BOAs have been identified as containing dense patches of regrowth native woody weeds, also referred to as "shiny bushes" (*Olearia elliptica, Dodonaea viscosa* and *Beyeria viscosa*), which are encroaching on areas of grassy Box Gum Woodland. These native woody weeds are colonising species which encroach on Box Gum Woodland which has been exposed to past disturbances and which lacks appropriate fire management. As a result of the encroachment, the structural characteristics and floristic composition of the vegetation community are altered from grassy to shrubby Box Gum Woodland hence altering the fauna habitat it provides.

These patches of the native woody weeds are typically characterised by an understorey with lower species diversity and can lack a midstorey and/or canopy species. The high density of stems per hectare prevents the recruitment of some native groundcover, midstorey and canopy species.

The Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a) and Commonwealth's listing advice for 'White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands' (Threatened Species Scientific Committee 2006) indicate that healthy Box Gum Grassy Woodland communities

generally contain a 'few', 'occasional', 'sparse' or a 'patchy' shrub layer (i.e. shrub layer with a cover <30%). Therefore, in order to maintain a sparse shrub layer shiny bush encroachment must be managed to retain the grassy nature of the Box Gum Woodland in accordance with projects COAs to ensure long-term protection of these grassy habitats.

Specific measures regarding shiny bush thinning have been developed for each BOA (Appendix E). Overarching management controls employed across all BOAs may include:

- thinning will be restricted to those areas identified as containing high densities of shiny bush requiring management, where possible, shiny bush within these areas will be thinned to obtain and maintain <30% cover
- conservational grazing will be used, where appropriate. This method has been proven to successfully control *Dodonaea viscosa* in the Central West (Local Land Services 2014). Conservational grazing followed by an appropriate fire regime (as outlined below) is the optimal management method which will reduce numbers and density of shiny bush and enable natural recruitment of other native species whilst not disturbing the ground
- implementation of appropriate fire regimes, where required, may occur to reduce large populations and/or as a secondary measure to control follow-up germination and regrowth of seedlings
- mechanical removal may be required in some areas of the BOAs, which has been observed to work in the Central West (Local Land Services 2014).
- cleared material will be spread around the subject site to minimise weed establishment or used elsewhere as required
- areas subject to thinning will be regularly inspected to identify the establishment of any weed species and the requirements for active revegetation.

Biodiversity management consultation

Biodiversity issues relating to the Project Boundary and BOAs should be communicated through appropriate forums to enable an integrated biodiversity management approach within the locality and BTM Complex. Consultation which should be considered includes:

- Environmental representatives from each mine (as well as relevant agencies) to meet and discuss biodiversity issues within BOAs
- Annual Review report detailing overall biodiversity performance and outcomes of the BOAs using information provided from annual Biodiversity Monitoring Reports
- Liaison with adjoining land owners and managers, as appropriate, to discuss concerns including BOA indirect impacts on adjoining land holdings, emerging weeds and pests and opportunities to improve biodiversity links across properties and the broader landscape
- Liaison with local stakeholders such as NPWS, Landcare, Forestry Corporation of NSW, Narrabri Shire Council and LLS as appropriate to discuss biodiversity management actions and issues.

6.2.2.2 Restoration measures

Natural regeneration

Prior to active restoration, habitat restoration zones will be allowed to naturally regenerate. This will be promoted through the management of the following threatening processes as detailed in more detail above:

- Management of weeds and pests in accordance with the Weeds and Pest Management Strategy (Appendix C)
- Pine thinning and native woody weed management
- Control burns
- Nutrient and erosion management
- Exclusion of livestock grazing (where appropriate, in conjunction with conservational grazing).

Incorporating management options as detailed above will encourage native canopy species and native grasses and forbs to regenerate naturally.

Where natural regeneration of canopy species is not observed following 10 years of management measures being implemented active revegetation should be implemented.

Collect and propagate seed

To ensure the genetic diversity in species found in the Brigalow Belt South is maintained through seed collection and propagation.

Overarching management control regarding the collection and propagation of seed within the BOAs include:

- collect native seed for the establishment of native vegetation, in accordance with the RMP and Florabank Guidelines (FloraBank 2018)
- if sufficient seed resources are available, undertake seed collection in the local area
- collect seed from the three broad native vegetation classes (native grasslands, grassy woodland on fertile soils and shrubby woodlands/ open forest on skeletal soils) including the threatened Box Gum Grassy Woodland community as detailed in Table 6.6
- collect seed from a wide variety of species present in each vegetation class
- ensure that plants are propagated and raised in a nursery.

Active revegetation

Revegetation directly promotes species diversity and structure, reduces the risk of erosion and salinity, improves soil condition and provides habitat and refuge for locally occurring and nomadic species of fauna.

Revegetation works within the BOAs will be completed generally in accordance with the Commonwealth Government's *Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010a).

The majority of revegetation areas will target areas where natural regeneration is unlikely to occur and where natural regeneration require supplementary planting to meet appropriate performance and completion criteria as detailed in Section 7.4. Most of these areas occur adjacent to remnant vegetation providing connectivity and maximising the likelihood of success of native species reestablishment. While it is impractical to restore the Box Gum Grassy Woodland communities and other vegetation types within the BOAs to their pre-European settlement states, realistic restoration targets such as enhancing native species diversity, controlling exotic species, while increasing the area, connectivity and diversity of these sites are likely to be achieved.

The planted species and revegetation methods will vary within each BOA. Revegetation methods will include mechanical direct seeding, hand spot planting and hand broadcasting/ niche seeding. Deep ripping will be undertaken at least three months before planting in areas extensively grazed by livestock and where terrain and tree densities permit.

Overarching management controls regarding the revegetation of BOAs include:

- revegetation will generally not be undertaken in habitat management zones, where remnant native woodland vegetation exists in good condition with limited disturbances and exotic species present
- revegetation within Habitat Restoration Zones and Corridor enhancement zones will be undertaken using a staged approach to improve vegetative structure and allow for the integration of responsive measures identified through monitoring and evaluation
- species selected for planting will be from the Brigalow Belt south bioregion
- where practicable, seedlings will be protected from native and exotic grazers by tree guards and/or fencing
- survival rates and growth of revegetated areas will be monitored, where possible, additional deep watering events will occur where survival rates are low i.e. <80% survival rates
- planting methods will where practicable be consistent with surrounding vegetation communities. Vegetation will be planted/ seeded along natural contours and will not be planted in grid layouts
- depending on the vegetation community to the established the approximate seed quantities may comprise:
    - tree species — 200g/ha
    - shrub species — 300g/ha
    - grass species — 5,000g/ha.
- species selected for hand spot planting will be based on the target vegetation community, and may include a selection of species as detailed in Table 6.6. Seed mix attributes will be based on a mixture and abundance of the target species

- Box Gum Woodland revegetation to include a mix of grass, shrubs and tree species characteristic of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland threatened ecological community as per the NSW Scientific Final Determination (Office for Environment & Heritage 2011) and Commonwealth EPBC Act Policy Statement 3.5 species list (Department of the Environment and Heritage 2006).

The extent, timing and methodologies of revegetation to be employed across the BOAs will be determined on an annual basis. An indicative revegetation schedule is provided in Appendix E (Figure E-32). Prior to commencing revegetation works a site inspection would be undertaken by a suitably qualified person to identify areas which should be targeted to identify specific methods required i.e. soil preparation, weed management, thinning and seed/tube stock densities and composition.

The methods used in soil preparation and revegetation are described below.

Deep ripping

Selected areas within Habitat Restoration Zones and Corridor enhancement zones will be deep ripped to prepare soil beforehand broadcasting and hand spot planting. Deep ripping assists root development by increasing soil aeration and water infiltration. Soil to be planted with trees and shrubs will be deep ripped. Preparation for planting groundcover species will be prepared using equipment, baseline monitoring data and completion criteria to determine the success of the management measures.

Table 6.6 Species list

Scientific name	Common name	Growth form	Target vegetation community[1]			
			Grassy Box Gum Woodland[2]	River Red Gum	Poplar Box woodland	Ironbark Shrubby Forest
Angophora floribunda	Rough-barked Apple	Tree	-	2	-	-
Eucalyptus albens	White Box	Tree	3	-	1	1
Eucalyptus blakelyi	Blakely's Red Gum	Tree	1	1	1	-
Eucalyptus camaldulensis	River Red Gum	Tree	1	3	-	-
Eucalyptus crebra	Narrow-leaved Ironbark	Tree	1	-	-	3
Eucalyptus melliodora	Yellow Box	Tree	1	1	-	-
Eucalyptus piligensis	Piliga Box	Tree	-	-	3	
Eucalyptus populnea	Poplar Box	Tree	1	-	3	-
Callitris endlicheri	Black Cypress Pine	Tree	1	-	-	1
Callitris glaucophylla	White Cypress Pine	Tree	2	-	2	2
Casuarina cunninghamii	River Oak	Tree	-	2	-	-
Melaleuca bracteata	Bracteata Honey Myrtle	Shrub	-	2	-	-
Acacia decora	Western Golden Wattle	Shrub	1	-	2	2
Acacia cheelii	Motherumbah	Shrub	-	-	1	1
Beyeria viscosa		Shrub	-	-	2	2
Breynia oblongifolia	Coffee Bush	Shrub	-	-	1	1
Bursaria spinosa	Native Blackthorn	Shrub	-	-	1	1
Cassinia sp.		Shrub	1	-	1	1
Dodonaea tenuifolia		Shrub	-	-	1	1
Dodonaea viscosa		Shrub	1	-	2	2
Geijera parviflora	Wilga	Shrub	1	1	1	1
Hibbertia obtusifolia		Shrub	1	-	1	1
Indigofera australis		Shrub	1	-	1	1
Notelaea microcarpa	Native Olive	Shrub	2	1	2	2
Olearia elliptica	Sticky Daisy Bush	Shrub	-	-	2	2
Pimelea curviflora		Shrub	-	-	1	1
Pimelea microcephala		Shrub	-	-	1	1
Aristida ramosa	Threeawn Speargrass	Grass	1	1	3	3
Aristida vagans		Grass	1	-	1	1
Austrodanthonia bipartita	Wallaby Grass	Grass	1	1	1	2
Austrodanthonia ramosa	Wallaby Grass	Grass	1	1	1	1

Scientific name	Common name	Growth form	Target vegetation community[1]			
			Grassy Box Gum Woodland[2]	River Red Gum	Poplar Box woodland	Ironbark Shrubby Forest
Austrodanthonia setacea		Grass	2	1	1	1
Austrostipa scabra	Speargrass	Grass	2	1	2	2
Bothriochloa decipiens	Red Grass	Grass	1	1	1	2
Bothriochloa macra	Red Grass	Grass	1	1	1	1
Chloris truncata	Windmill Grass	Grass	1	1	1	1
Chloris ventricosa	Tall Chloris	Grass	1	-	1	1
Cymbopogon refractus	Barbed Wire Grass	Grass	2	-	2	2
Cynodon dactylon	Couch	Grass	-	1	-	-
Dichanthium sericeum	Queensland Bluegrass	Grass	2	-	1	1
Eragrostis lacunaria	Purple Lovegrass	Grass	1	-	1	1
Eragrostis laniflora	Wollybutt	Grass	1	-	1	1
Eragrostis leptostachya	Paddock Lovegrass	Grass	-	1	1	1
Panicum effusum	Hairy Panic	Grass	2	1	2	2
Themeda australis	Kangaroo Grass	Grass	2	1	1	1
Lomandra multiflora		Graminoid	1	2	-	-
Lomandra longifolia		Graminoid	-	2	-	-
Arthropodium milleflorum	Vanilla Lily	Herb	-	-	1	1
Asperula conferta	Common Woodruff	Herb	1	1	2	2
Brunoniella australis	Blue Trumpet	Herb	1	1	2	2
Caesia parviflora	Pale Grass Lily	Herb	1	-	1	1
Calotis sp.	Burr Daisy	Herb	1	1	2	2
Desmodium brachypodum	Large Tick-trefoil	Herb	2	-	2	2
Dianella spp.		Herb	1	-	1	1
Dichondra repens	Kidney Weed	Herb	1	2	1	1
Swainsona sp.		Herb	1	1	1	1
Swainsona swainsonioides		Herb	1	1	1	1
Vittadinia cuneata	Fuzzweed	Herb	2	1	2	2
Glycine clandestina		Climber	1	1	1	1
Glycine tabacina		Climber	1	2	2	2
Cheilanthes distans		Fern	1	1	1	1
Cheilanthes sieberi	Mulga Fern	Fern	1	1	1	1

1. Relative abundance of species to be restored in each vegetation type. - = very low density, 1 = low density, 2 = moderate density, 3 = high density.
2. Grassy Box Gum Woodland refers to White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC revegetation.

6.2.3 Agricultural suitability assessment

An agricultural suitability assessment has been completed for the Corridor Enhancement and Other Lands for Agriculture management zones as identified within the BOS (refer to Appendix H). The assessment was undertaken to identify the agricultural values of these lands and to determine the impact of removing either or both management zones from agricultural production.

The assessment of these lands was developed using a standard data sheet for representative sites in each of the separate areas allocated to the Corridor and Agriculture zones.

The site values collected for each portion of land were subsequently allocated a scaled agricultural value in accordance with the following criteria:

- Low — Dry Sheep Equivalent (DSE) rating for total area of unit less than 100
- Medium — DSE rating for total area of unit from 101-300
- High —DSE rating for total area of unit is above 301.

A map of these proposed agricultural values is provided in Figure 8-2. Where practically feasible BCOPL will maintain the agricultural use of areas identified as having medium to high agricultural values.

Within the proposed Corridor Enhancement Zone, agricultural use will be restricted in the short-term (5 years) immediately following the supplementary planting of canopy trees. However, once plantings are suitably established these areas will be re-established and managed for agricultural use.

This assessment does not include Sunshine or Nioka North BOAs as these properties have recently been purchased. Both of these BOAs are currently being grazed by cattle particularly on the lower slopes and grassland areas. It is likely that the current areas of grazing have a medium to high DSE rating, however this needs a through agriculture assessment to confirm.

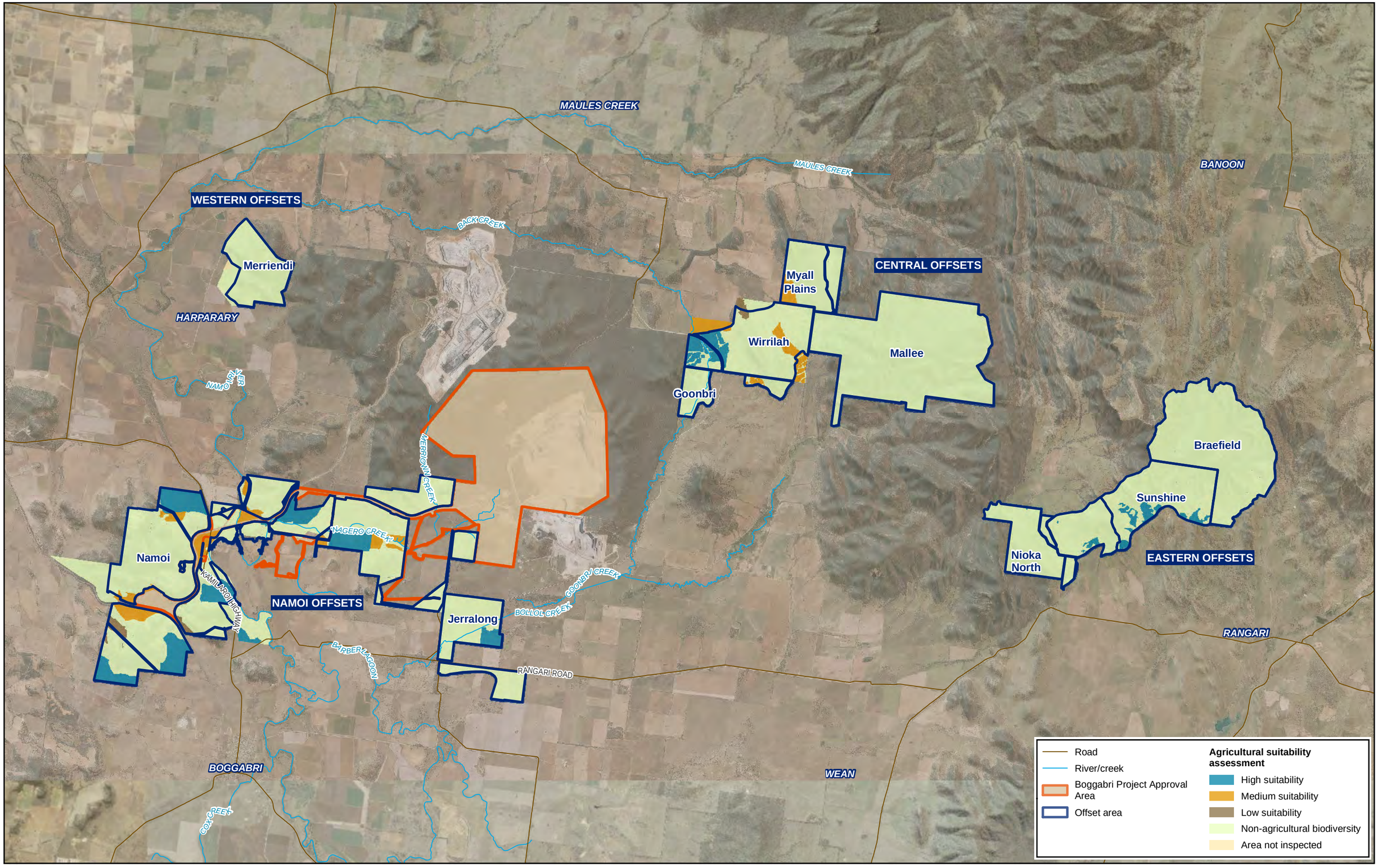


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FIGURE 6.3

TITLE. AGRICULTURAL SUITABILITY ASSESSMENT

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7. Biodiversity monitoring

7.1 Monitoring within the Project Boundary

7.1.1 Annual monitoring of the operational impacts of the Project on the surrounding environment

Monitoring of the operational impacts of the Project on Leard State Forest has been undertaken annually since 2006 (monitoring program also referred to as BACI monitoring). The monitoring is undertaken in spring (previously undertaken on a seasonal basis) and comprises surveys of flora, vertebrates and invertebrates, as described in more detail below.

The existing program involves monitoring replication sites within three analogue locations:

- Location 1 — Leard State Forest - adjacent to, but not within, the mining impact area (Figure 7.1)
- Location 2 — Central Offset Area (relocated from Vickery State Forest) (Figure 7.2)
- Location 3 — Namoi Offset Area (Figure 7.3).

In order to detect potential operational impacts of the Project on Leard State Forest, statistical analysis will continue to be used to compare environmental conditions within Leard State Forest with those of the distant control locations.

The monitoring of operational impacts of the Project on the surrounding environment will utilise the commonly accepted monitoring program design 'Beyond BACI' (Underwood 1992). This design contains the minimum number of replicates and times in order to detect changes as a result of mining activities. Statistical analysis of previous monitoring stages has indicated the number of control sites is suitable to detect biological significant change. At each of the replicate sites (12 sites); the following variables will be measured:

- Vegetation transects, including species, vegetation cover and measures of tree health. Two transects, each of 100 m from a marked point in set directions.
- Two 20-minute area bird searches within 80 m (approximately 2 ha) of fixed monitoring sites on non-consecutive mornings.
- Anabat recordings to quantitatively record bat species and activity within the area over two non-consecutive nights (Anabat SD1/ SD2 or Anabat Express Bat detector units set to record from dusk).
- Invertebrates captured in 20 small pitfall traps at 10 m intervals along two 100 m transect (10 small pitfalls per 100 m transect, left in place for four nights).

These methods are described in more detail below.

7.1.1.1 Monitoring survey methodology

The sections below outline the survey techniques employed as part of monitoring of the operational impacts of the Project on the surrounding environment.

Vegetation transects

The vegetation transect surveys would involve an assessment of vegetation cover abundance of two randomly placed 100 m transect at each of the replicate survey sites. Each species observed along the transect (point of direction) would be recorded and allocated a rating based on the vegetation cover abundance of the species along the entire transect.

Bird survey

The diversity and abundance of birds will be recorded from each replicate survey site using area searches within 80 m (approximately 2 ha) of the fixed monitoring sites. Designated surveys will be completed twice for 20 minutes on non-consecutive mornings, with birds identified to species level based on call recognition and/ or observation. Opportunistic records will be collected during the entire survey period.

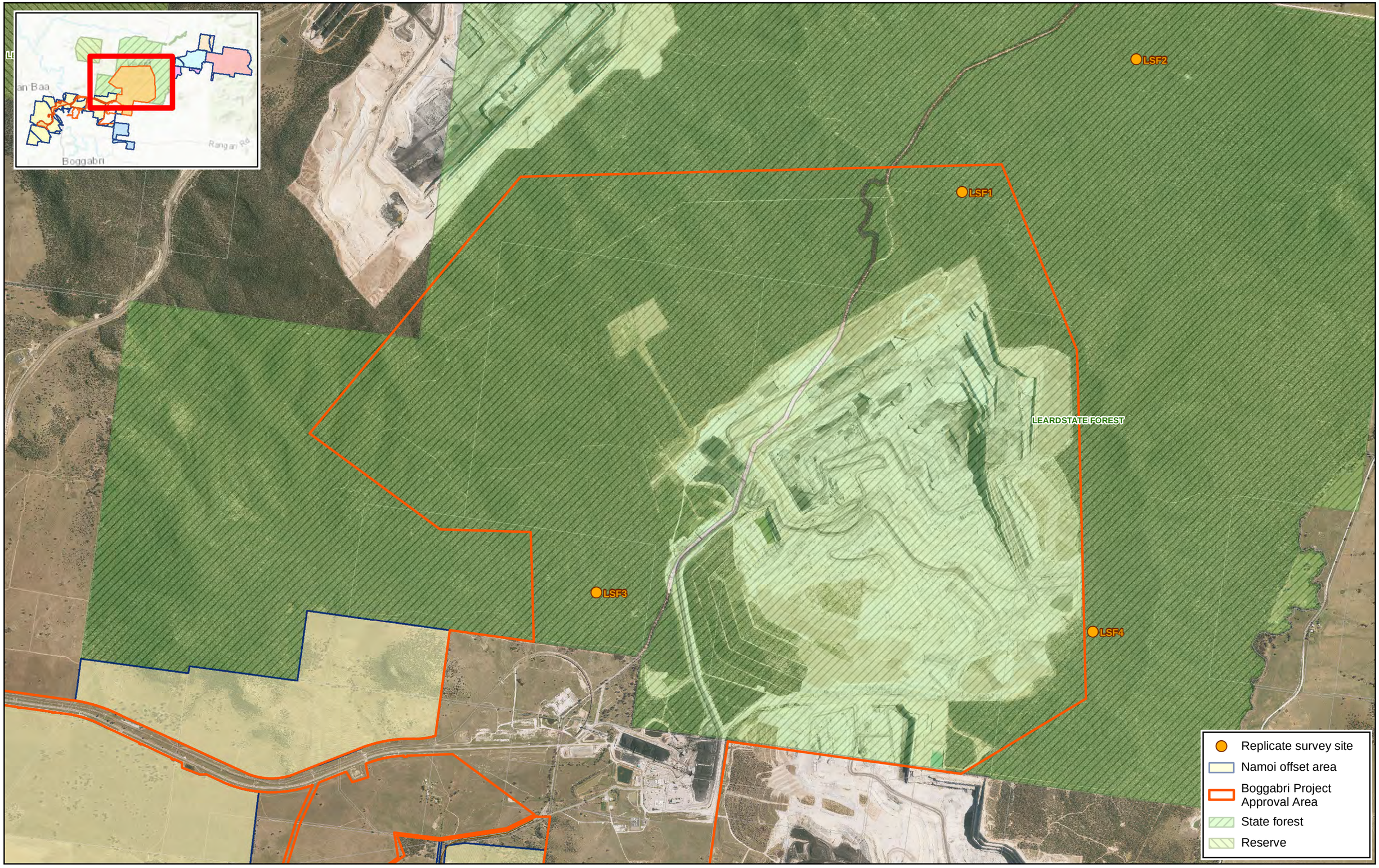
Microchiropteran bat survey

Ultrasonic Anabat bat detection (Anabats, Titley Scientific, Ballina NSW) would be used to passively record the echolocation calls of microchiropteran bats foraging at each replicate monitoring site. Whilst the Anabat bat detectors would be set to record throughout the night, calls recorded up to two hours after last light would be analysed using Analook software with reference to 'Bat Calls of NSW: Region Based Guide to the Echolocation Calls of Microchiropteran Bats' (Pennay et al. 2004) and species specific reference calls collected form Leard State Forest and within the Boggabri Coal locality.

Invertebrate survey

Pitfall traps will be used to sample invertebrate diversity. Within each site, ten pitfall traps will be placed along two 100 m transects, with each pit spaced approximately ten metres apart. Each pitfall will consist of a 150 mm tall, 60 mm wide plastic container dug into the ground with the opening at ground level. Each pit will be filled with approximately 3 cm of 70% ethanol solution in order to kill and preserve any captured invertebrates. Invertebrates will be identified to morphological type under a binocular microscope (x10 magnification).

Pitfall traps will be left open for four nights and three days.



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Coordinate System: GDA 1994 MGA Zone 56
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Imagery:
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DATE.	5/09/2018

FIGURE 7.1

TITLE. LOCATION OF REPLICATE SURVEY SITES - LEARD STATE FOREST

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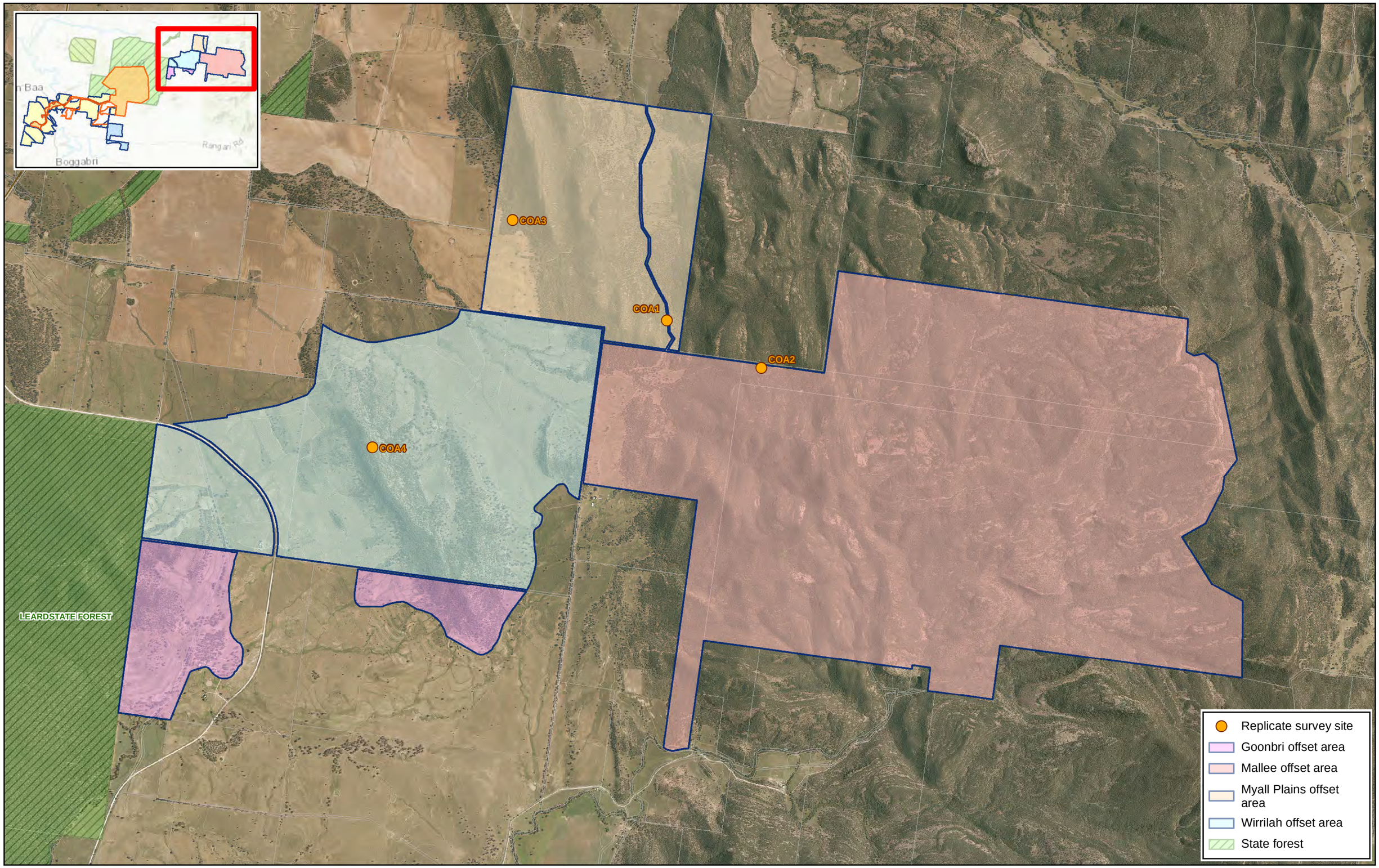

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AUTHOR. suansrir

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FIGURE 7.2

TITLE. LOCATION OF REPLICATE SURVEY SITES - CENTRAL OFFSET AREA

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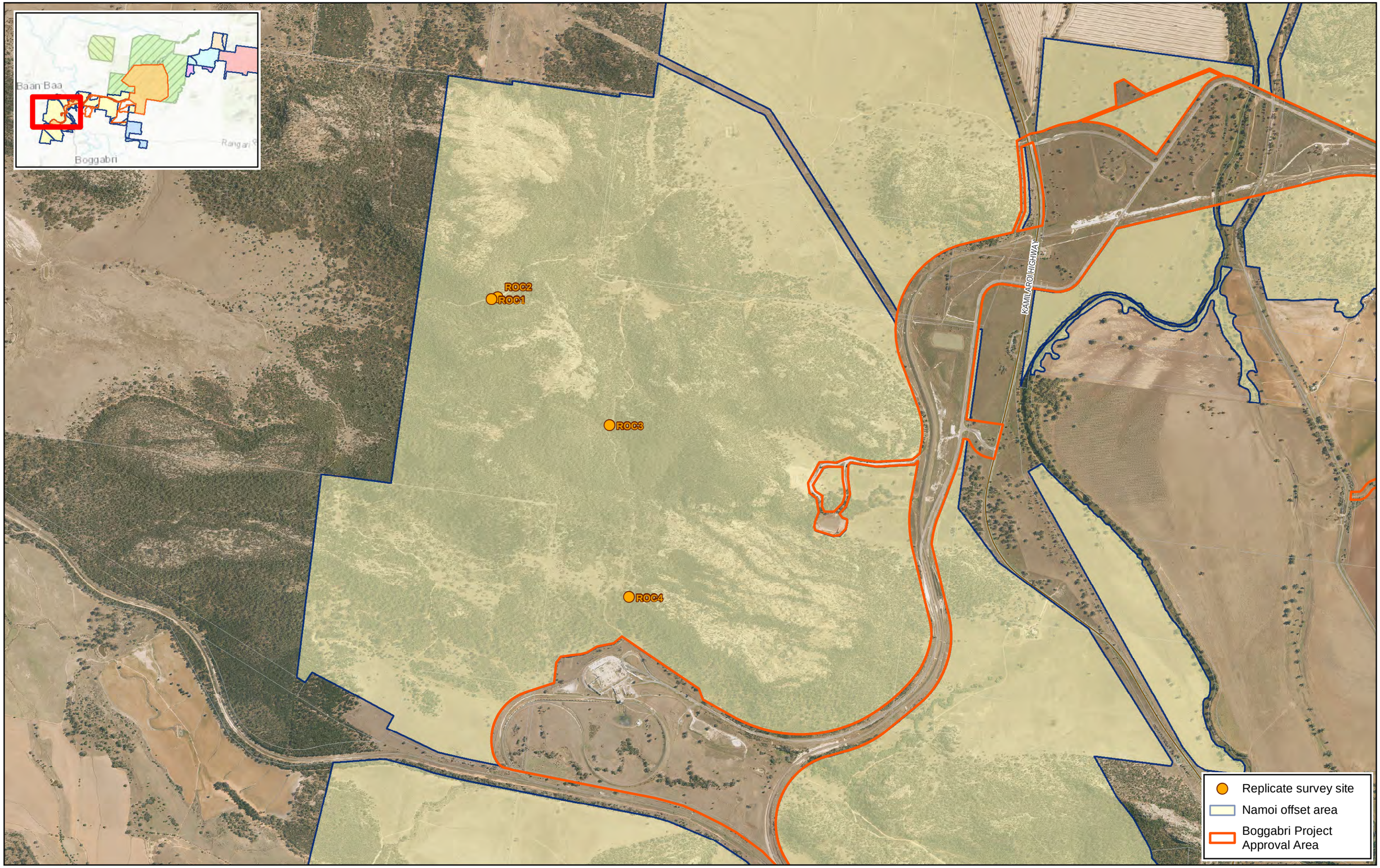

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Imagery:
BCPL (2018); Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS,

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FIGURE 7.3

TITLE. LOCATION OF REPLICATE SURVEY SITES - NAMOI OFFSET AREA

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7.1.2 Biodiversity corridor monitoring

Monitoring of the existing biodiversity corridor has been undertaken annually since 2013 to monitor operational impacts of the Project on the biodiversity corridor. General monitoring, comprising vegetation and vertebrate methodologies, is undertaken annually in spring in conjunction with other biological monitoring programs associated with the project boundary. In addition, targeted seasonal monitoring techniques are completed for Swift Parrot, Regent Honeyeater and Corben's Long-eared Bat. Monitoring methodologies are described in more detail below.

7.1.2.1 General survey methodology

Four replicate survey sites have been established within the existing biodiversity corridor (Figure 7.4). A summary of the survey methodologies required to be undertaken at each of these survey sites include:

- One BioBanking plot (described in detail in Section 7.2.1.1, Insert 5 and Table 7.2).
- Two nights of passive Anabat detection (described in Section 7.2.1.1).
- Two 20-minute area searches within 80 m (approximately 2 ha) of fixed monitoring sites on separate mornings (described in Section 7.2.1.1)
- Two consecutive nights of passive infra-red/ motion sensor camera detection (refer Section 7.2.1.1).

In addition to infra-red/ motion sensor cameras, observations of pest animals would be recorded opportunistically during any other biodiversity corridor inspection. For significant pest animal occurrences or observed pest animal damage, the date, location, activity, density and pest animal species would be recorded and communicated to the Environmental Superintendent.

Additional monitoring methodologies would be incorporated into this program on a needs basis; particularly if the biodiversity corridor is augmented with habitat feature such as nest boxes and salvaged woody debris. In accordance with the Leard Forest Regional Biodiversity Strategy (Stage 2 – Strategy Report) (Umwelt (Australia) Pty Limited 2017), this BMP would be updated to include monitoring techniques such as nest box monitoring using inspection cameras and salvaged resource monitoring, which would likely entail a time-standardised herpetofauna search and/ or remote camera traps.

Frequency

The general survey methodologies described in Section 7.1.2.1 will be used to monitor the biodiversity corridor annually for five years, up to and inclusive of the year 2022. From the year 2023, monitoring of the biodiversity corridor may be considered biennially.

Analogue sites

Replicate monitoring sites (LSF1, LSF2, LSF3, LSF4) associated with annual monitoring of the operational impacts of the Project on Leard State Forest (Section 7.1.1) will be

used as analogue sites for comparative analysis. In this regard, methodologies detailed in Section 7.1.2.1 will require replication at the four analogue sites.

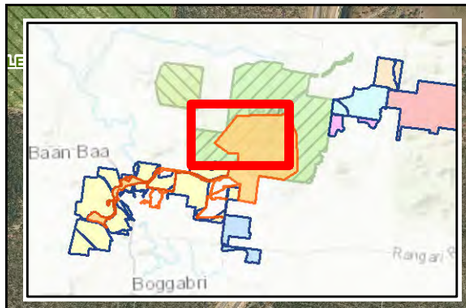
7.1.2.2 Targeted fauna monitoring

Particular interest is afforded to the Regent Honeyeater, Swift Parrot and Corben's Long-eared Bat, which the EPBC Act CoA for the Project identified as requiring habitat within the biodiversity corridor to maintain ecosystem functionality such as landscape scale movement opportunities between habitat areas. Targeted seasonal surveys for these species will be completed as detailed in Table 7.1.

Table 7.1 Variables to be measured during targeted fauna monitoring in the biodiversity corridor

Target species	Methods	Effort	Frequency	Season
Regent Honeyeater	Targeted searches in suitable habitat[1]	1 day per season	Annually	Autumn/Winter[2]
Swift Parrot	Targeted searches in suitable habitat[1]	1 day per season	Annually	Autumn/Winter[2]
Corben's Long-eared Bat	Harp trapping[3]	8 trap nights over 2 nights[4]	Annually	Spring or Summer

Notes: 1) Targeting areas of heavily flowering eucalypts 2) Key foraging resources for Regent Honeyeater and Swift Parrot in the Boggabri locality is the winter flowering *Eucalyptus albens* (White Box). Therefore, as far as reasonably practicable, surveys will be undertaken annually to coincide with BirdLife Australia's National Regent Honeyeater and Swift Parrot Survey periods in May and August. 3) Corben's Long-eared Bat cannot be identified from echolocation call alone and trapping is required to confirm the presence of this species. 4) Depending on accessibility and efficacy of trap locations, some harp traps may be positioned in Leard State Forest adjacent to the biodiversity corridor.



LC2

LC3
LC4

LEARDSTATE FOREST

LC5

Replicate survey site
Namoi offset area
Boggabri Project Approval Area
State forest
Reserve

Leard State Forest Wildlife Corridor

Boggabri Project Area
Maules Creek mine area

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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Imagery:
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MINE NAME. 2171706A_GIS_BMP027_A1

AUTHOR. suansrir

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DATE. 6/09/2018

FIGURE 7.4

TITLE. LOCATION OF MONITORING REPLICATE SURVEY SITES - BIODIVERSITY CORRIDOR

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7.1.3 Mine rehabilitation monitoring

Monitoring of the mine rehabilitation areas will be undertaken to assess the positive and negative outcomes of rehabilitation measures employed by BCOPL. Monitoring of the rehabilitation areas has been undertaken annually since 2012 as part of the Leard State Forest monitoring program in spring (previously undertaken on a seasonal basis). The monitoring program comprises surveys of flora, vertebrates and invertebrates, as described in more detail below.

7.1.3.1 Monitoring survey methodology

Seven replicate survey sites have been established within the mine rehabilitation area. A summary of the survey methodologies required to be undertaken at each of these survey sites on an annual basis include:

- Two (randomly selected) 100 m transect surveys of vegetation and cover abundance (described in detail in Section 7.1.1).
- One BioBanking plot (described in detail in Section 7.2.1.1, Insert 5 and Table 7.2).
- Two nights of passive Anabat detection (described in Section 7.2.1.1)
- Two 20-minute area bird searches within 80 m of fixed monitoring sites on separate mornings (described in Section 7.2.1.1).
- Two 100 m transects with 10 invertebrate pitfall traps in each transect (described in Section 7.1.1.1).
- Two consecutive nights of passive infra-red/motion sensor camera detection (described in Section 7.2.1.1).
- Salvaged woody debris monitoring. Monitoring will occur following the augmentation of mine rehabilitation areas with salvaged woody debris. Replicate monitoring sites would be sampled for 30 person minutes within an approximate 1 ha area (~56 m radius) on each of two separate days.
- Nest box monitoring (procedure described in Section 7.2.1.1).

In addition to infra-red/ motion sensor cameras, observations of pest animals would be recorded opportunistically during any other mine rehabilitation inspection. For significant pest animal occurrences or observed pest animal damage, the date, location, activity, density and pest animal species would be recorded and communicated to the Environmental Superintendent.

7.1.3.2 Frequency

The survey methodologies described in Section 7.1.3.1will be used to monitor the mine rehabilitation annually for five years, up to and inclusive of the year 2022. From the year 2023, monitoring of the mine rehabilitation may be considered biennially.

7.1.3.3 Analogue sites

Replicate monitoring sites (LSF1, LSF2, LSF3, LSF4) associated with annual monitoring of the operational impacts of the Project on Leard State Forest (Section 7.1.1.1) will be

used as analogue sites for analysis of fauna species richness and abundance. In this regard, methodologies detailed in Section 7.1.3.1 (excluding nest box monitoring) will require replication at the four analogue sites.

Vegetation attributes will be analysed against BBAM benchmarks (Table 7.7), as described in Section 7.3.

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AUTHOR.	suansrir
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DATE.	6/09/2018

FIGURE 7.5

TITLE. LOCATION OF REPLICATE SURVEY SITES - MINE REHABILITATION AREA

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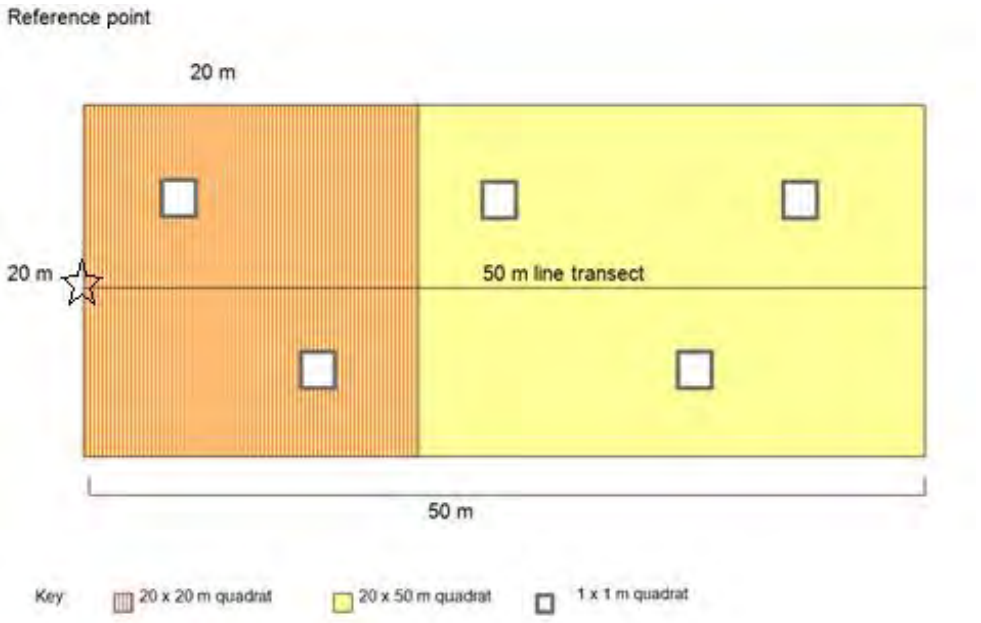
7.2 Annual BOA monitoring

The BOAs encompass greater than 10,000 ha throughout which 60 permanent monitoring sites have been established (Figure 7.6). Collectively, these monitoring sites have been monitored in 2012, 2014 to present. Annual BOA monitoring involves surveying of both terrestrial flora and fauna species using the techniques outlined below.

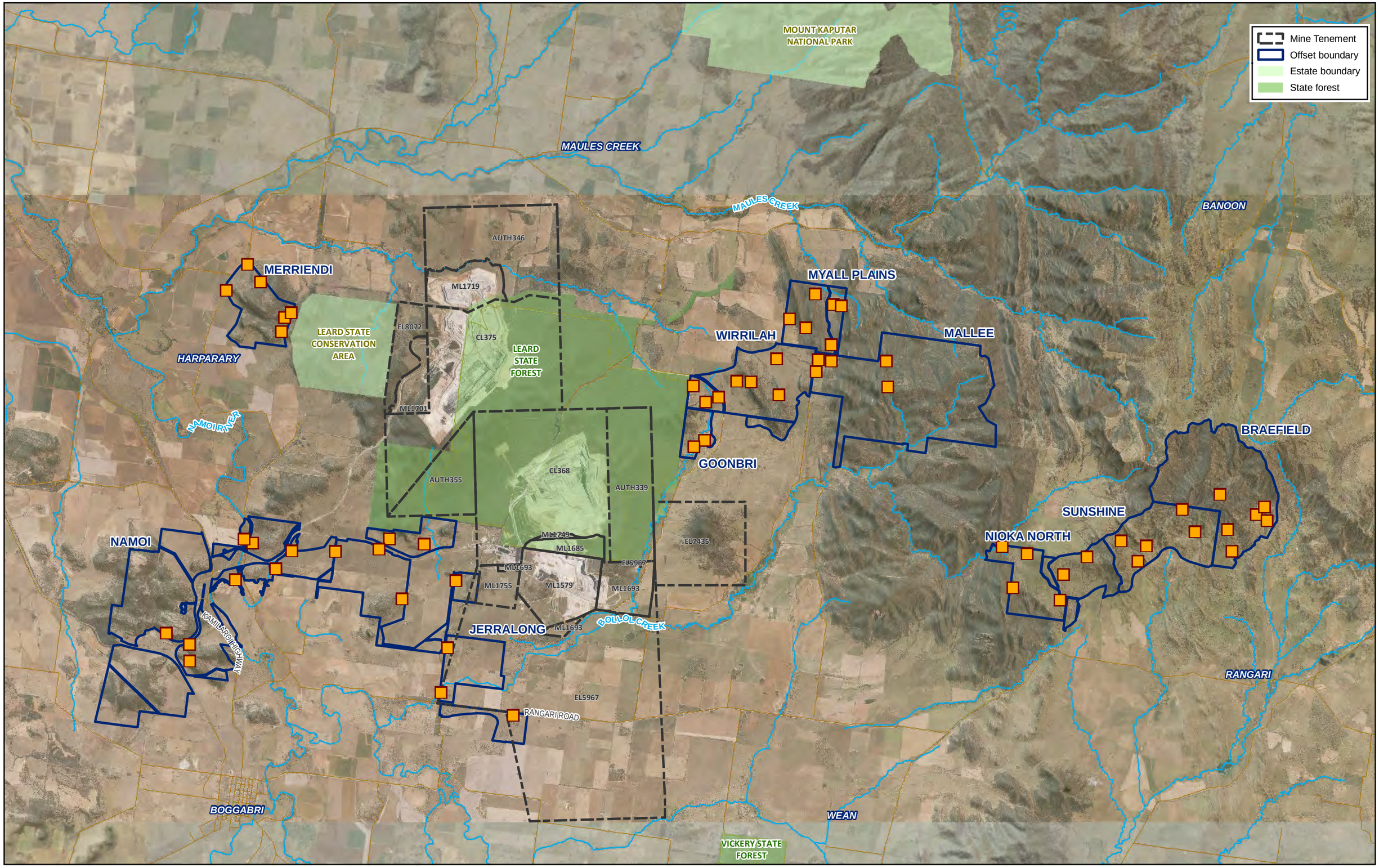
7.2.1.1 Monitoring survey methodology

Vegetation transects and quadrats

Flora monitoring involves detailed quantitative site surveys in accordance with the *BioBanking Operation Manual and Biodiversity Assessment Methodology* (Department of Environment Climate Change 2009; Office of Environment and Heritage 2014)and photo point monitoring. Details of the survey methodology is provided below and depicted in Insert 5 and Table 7.2.



Inset 5 — Schematic diagram illustrating the layout of the nested 20 x 50 m and 20 x 20 m quadrats used for the assessment of condition attributes at each site



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MINE NAME.	2171706A_GIS_BMP031_A1
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DATE.	3/12/2018

FIGURE. 7.6

TITLE. LOCATION OF REPLICATE SURVEY SITES

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Table 7.2 Variables to be measured during flora monitoring

Variable	Attribute	Plot or transect type	Description
Canopy	Species richness	20 x 20 m plot	A count of the total number of canopy species
	% canopy cover	Measured at 10 points along 50 m line transect (i.e. every 5 m)	An estimate of percent foliage cover for the canopy
	Number of trees with hollows	50 x 20 m plot	A count of the total number of living and dead trees with at least one hollow
	Regeneration	50 x 20 m plot	The proportion of canopy species regenerating (i.e. seedlings / saplings)
Midstorey	Species richness	20 x 20 m plot	A count of the total number of midstorey species
	% Midstorey cover	Measured at 10 points along 50 m line transect (i.e. every 5 m)	An estimate of percent foliage cover for the midstorey
Ground layer	Species richness	20 x 20 m plot	A count of the total number of ground cover species
	% native ground cover (grasses)	Measured at 50 points along a 50 m line transect (i.e. every 1 m)	Records of whether native grass intersects defined points along the transect to derive % cover.
	% native ground cover (shrubs)		Records of whether native shrubs intersect defined points along the transect to derive % cover.
	% native ground cover (other)		Records of whether native other (forbs, ferns, etc.) intersects defined points along the transect to derive % cover.
	Coarse woody debris (fallen logs)	50 x 20 m plot	Total number and combined length of all sections of dead fallen timber ≥ 10 cm diameter, ≥ 0.5 m in length, and completely detached from living or dead standing trees
Weed species	Species richness	20 x 20 m plot	Total number of weed species
	% cover	Measured at 50 points along a 50 m line transect (i.e. every 1 m)	An estimate of percent foliage cover for weed species in the canopy and midstorey Records of whether ground cover weeds intersect defined points along the transect to derive % cover.
	Major weed infestations or invasion of native species	General observations	Record of species, location, size and density as required.

Variable	Attribute	Plot or transect type	Description
Groundcover	% cover of leaf litter, vegetation, bare ground, rock, cryptograms	5 1 x 1 m quadrats along either side of 50 m transect	An estimate of percent cover of groundcover attributes to determine groundcover composition
Canopy abundance (stem counts) and stem classes	Abundance of trees per hectare and diversity of stem classes	50 x 20 m plot	Count of number of individual trees by species and stem class ranges (<5 cm, 5-9 cm, 10-19 cm, 20-29 cm, 30-49 cm, 50-79 cm and 80+cm).
Disturbance	Clearing, cultivation (grazing and trampling), storm, flood or fire damage, soil erosion, firewood collection, salinity, feral herbivores.	Within and adjacent monitoring location.	Presence/absence of each attribute will be recorded.
Overall health and structure		Single photograph of 50 m transect	A single photograph taken from the start of the transect in the direction of the transect.

Additional vegetation transects and quadrats may require establishment and monitoring to assess the impacts of fuel reduction control measures (i.e. control burns) particularly for Box Gum Woodland should control burns be deemed necessary. The requirements and monitoring procedures for these additional monitoring sites will be reviewed and determined as required.

Frequency

Vegetation transects and quadrats will be completed at each replicate monitoring site in spring in conjunction with general vertebrate survey methodologies. In addition, those replicate monitoring sites commensurate with White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland (EEC/ CEEC) will also be sampled in autumn for consistency with the Leard Forest Regional Biodiversity Strategy (Stage 2 – Strategy Report) (Umwelt (Australia) Pty Limited 2017).

State and Transition Model

A key element of the monitoring within the BOAs is to determine the condition of White Box Woodland remnants in accordance with the State and Transition model for box gum grassy woodlands. The State and Transition model is a way to think about the condition of woodland, how it got to be that way, and what changes are possible with management actions. The baseline survey will be used throughout the BOA monitoring to delineate the vegetation within the BOAs into "States" as follows:

- State 1: grassy woodland
- State 2: native pastures and woodland
- State 3: fertilised pastures
- State 4: crops and sown pastures
- State 5: revegetated areas.

Using the State and Transition model during the monitoring of the BOAs, any transition from a state can be detected and hence the effectiveness of management actions can be gauged. The indicators outlined in Table 7.3 will be used to determine the current state of the vegetation within the BOAs (for states 1 – 3) and to determine any transition between states as monitoring progresses.

Table 7.3 Indicator species to be used for states 1, 2 and 3 within BOAs

Variable	Indicators		
	State 1	**State 2**	**State 3**
Canopy	A range of ages, from mature trees with hollows to seedlings.	The dominant canopy species are present, with a good representation of tree ages (excludes derived grasslands).	Canopy species are still present in woodlands though there are few young trees and seedlings.
Shrubs	Many of the leguminous (pod-bearing) shrubs are found only in State 1. Due to their high nutritional value, young plants are quickly grazed out in other states. Examples include Wattles (*Acacia* spp.), Indigos (*Indigofera* spp.), Common fringe-myrtle (*Calytrix tetragona*), Bush-peas (e.g. *Pultenaea* spp., *Daviesia* spp., *Dillwynia* spp.), and Cryptandras (*Cryptandra* spp.).	While many shrubs are still present in State 2, they are likely to be mostly the colonising species like Cassinias. Grazing-sensitive shrubs such as most of the wattles, the indigos and cryptandras are probably no longer present unless protected. Examples include some heaths, such as urn heath (*Melichrus urceolatus*) and peach heath (*Lissanthe strigosa*) persist where protected, and Grey Guinea-flower (*Hibbertia obtusifolia*).	Most shrubs in State 3 will be exotic. Native shrubs that persist in State 3 are those that are highly unpalatable due to thorns or other features. Examples include Blackthorn (*Bursaria spinosa*), and Cassinias, Chinese shrub, sifton bush, etc (*Cassinia* spp.).
Groundcover – forbs (wildflowers)	Plants with tall, flowering stems which are sensitive to grazing may only be found in State 1 including many lilies, orchids and daisies. Examples include Native flax (*Linum marginale*), Donkey orchids (Diuris spp.) and sun orchids (*Thelymitra* spp.), and Yam daisy/murrnong (Microseris lanceolata).	Forbs are transitional in form, between the tall, fleshy plants found in State 1 and those of shorter stature that are often found in State 3. State 2 forbs will often have persistent root stock, tough, rough or hairy leaves, which makes them more resistant to grazing. Examples include Sedges (*Carex spp.*), Mat-rushes (*Lomandra spp.*), Early Nancy (*Wurmbea dioica*), Chocolate lilies (*Dichopogon spp.*), Common buttons (*Chrysocephalum apiculatum*), Native plantains (*Plantago spp.*), Common raspwort (*Gonocarpus tetragynus*).	In general, the groundcover in State 3 will have traits adapted to elevated nutrients, competition and grazing. These plants will be annuals (a), short-lived perennials (sp), short-flowering (sf), rosette forming (r) or stoloniferous (st). Examples include Bluebells (*Wahlenbergia spp.*) (sp), New Holland daisies (*Vittadinia spp.*) (sp), Austral sunray (*Triptilodiscus pygmaeus*) (a), Blue heron's-bill (*Erodium crinitum*) (a), Austral bear's-ear (*Cymbonotus lawsonianus*) (r), Solenogynes (*Solenogyne spp.*)(r),

Variable	Indicators		
	State 1	State 2	State 3
			Kidneyweed (*Dichondra repens*) (st).
Groundcover — grasses	Grasses that are typically sensitive to grazing will only persist in State 1. These include Kangaroo grass, Barbed-wire grass (*Cymbopogon refractus*), Wild sorghum (*Sorghum leiocladum*).	Many of the warm-season and highly grazing sensitive grasses found in State 1 are no longer present in State 2. Common State 2 grasses include Nine-awn grass (*Enneapogon nigricans*), Plume-grasses (*Dichelachne spp.*) and Common wheat-grass (*Elymus scaber*).	There are many native grasses that become more common with grazing. In State 3, these species will move towards co-dominance with the exotics that are present. Some examples include Weeping grass (*Microlaena stipoides*), Red grass (*Bothriochloa macra or B. decipiens*), Wallaby grasses (*Austrodanthonia spp.*), Purple wire-grass (*Aristida ramosa*).
Exotic species	Occasional woody weeds from seeds carried in bird droppings.	Shrubs including Blackberry (*Rubus fruticosus*), Briar rose (*Rosa rubiginosa*), and African box-thorn (*Lycium ferocissimum*). Groundcovers including Paterson's curse (*Echium plantagineum*), Capeweed (*Arctotheca calendula*), Fescues (*Vulpia spp.*), Bromes (*Bromus spp.*), Coolatai grass (*Hyparrhenia hirta*), African love-grass (*Eragrostis curvula*), and Thistles (various species).	Exotic species commonly found in State 3 are similar to those in State 2 but more abundant.

General vertebrate survey

The vertebrate monitoring program has been designed to take into account the slow recovery time for species re-colonisation and the time it will take for revegetation areas to develop habitat attributes. The monitoring program is focused on key indicator fauna species as opposed to attempting to monitor all species found on site in a broad-brush approach. The vertebrate monitoring will focus on diurnal birds and microchiropteran bats. A large proportion of the threatened species belong to these groups. Furthermore, monitoring these groups will provide valuable information on the progress of restoration in the BOAs than other fauna groups as they depend on the development of good quality habitats with complex structure for foraging, roosting and breeding habitat.

Details of the vertebrate survey methodology are provided in Table 7.4 and discussed in more detail below.

Table 7.4 Variables to be measured during general vertebrate monitoring

Species / group	Methods	Effort per site	Frequency	Season
Diurnal birds	Area search	20 minutes each on separate days	Annually	Spring
Microchiropteran bats	Ultrasonic call detection (Anabat)	2 consecutive nights	Annually	Spring
Nocturnal birds	Call playback	5 minutes of call broadcast, 10 minutes listening at a minimum of one site in each BOA	Biennial	Spring
Nocturnal mammals	Spotlighting	20 minutes at a minimum of one site in each BOA	Biennial	Spring
Terrestrial mammals and vertebrate pest	Infra-red/motion sensor cameras[1]	1 camera per monitoring location for 2 nights	Annually	Spring
Terrestrial mammals and Vertebrate Pest	Infra-red/motion sensor cameras	TBD	Continuous to be checked every 6 months	N/A

Notes: 1) In addition to infra-red/ motion sensor cameras, observations of pest animals would be recorded opportunistically during any other biodiversity offset inspection. For significant pest animal occurrences or observed pest animal damage, the date, location, activity, density and pest animal species would be recorded and communicated to the Environmental Superintendent.

Diurnal bird surveys – area search

The diversity and abundance of birds will be recorded from each replicate survey site using area searches (in similar habitat) within 80 m of the fixed monitoring sites. Designated surveys will be completed for 20 minutes during periods of high bird activity, predominately early morning or late afternoon, with birds identified to species level based on call recognition and/ or observation. Surveys will be completed at each sample site twice on separate days. Opportunistic records will be collected within each BOA during the entire survey period.

Nocturnal birds – call playback

Call playback is used to survey for the Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider and Koala using the methods of Kavanagh and Debus (1994) and Debus (1995). Call playback surveys involve broadcasting recordings of the vocalisations of animals to elicit a response, either vocal or behavioural. At each site an initial ten-minute listening period will be undertaken followed by a five-minute call broadcast and then a five-minute listening and spotlighting period. For each additional species, the 2 x 5 minute periods will be repeated. A final listening period of ten minutes is to be undertaken after call broadcasting is concluded. Calls will broadcast using a portable MP3 player and amplified through a megaphone. Call playback will be completed at a minimum of one replicate monitoring site associated with a habitat management zone within each BOA.

Microchiropteran bat surveys – ANABATS

Passive Ultrasonic Anabat Bat detection (Anabat SD1 CF Bat Detector – Titley Electronics, Ballina) will be used to record and identify the echolocation calls of microchiropteran bats foraging at each site. Passive monitoring of survey sites will be achieved by setting Anabat bat detectors to record throughout the night over two consecutive nights.

Bat call analysis to be undertaken using the guidelines of the Australasian Bat Society. Bat Calls of the Western Slopes and Plains (Pennay et al. 2004) will be used as a reference collection for bat call identification, as well as species specific reference calls collected in the project locality.

Terrestrial mammals and pests

To aid management practices in the BOAs, passive infra-red motion sensor cameras would be positioned at each replicate monitoring site to target terrestrial mammals and vertebrate pests. Passive monitoring of each BOA will be achieved by arming camera traps to record continuously over two consecutive nights in conjunction with appropriate bait. Furthermore, five long-term infra-red/motion sensor cameras will be established across the BOAs for a period of 12 months (subject to weather conditions and technical operation).

In addition to infra-red/ motion sensor cameras, observations of pest animals would be recorded opportunistically during any other biodiversity offset inspection. For significant pest animal occurrences or observed pest animal damage, the date, location, activity, density and pest animal species would be recorded and communicated to the Environmental Superintendent.

Targeted fauna monitoring

In accordance with the Project's EPBC Approval (EPBC 2009/5256), targeted surveys for Corben's Long-eared Bat, Swift Parrot and Regent Honeyeater are required annually in the BOAs. Monitoring will provide valuable information on the success of management measures as they depend on good quality habitats with complex structure for foraging, roosting and breeding habitat. In addition, nest boxes and salvaged woody debris installed to augment habitat restoration zones within the BOAs require targeted monitoring in accordance with the Leard Forest Regional Biodiversity Strategy (Stage 2 – Strategy Report) (Umwelt (Australia) Pty Limited 2017).

Details of the vertebrate survey methodology are provided in Table 7.5.

Table 7.5 Variables to be measured during targeted fauna monitoring in the BOAs

Target	Methods	Effort per offset area[2]	Frequency	Season
Regent Honeyeater	Targeted searches in suitable habitats[1]	1 day per season	Annually	Autumn/Winter[3]

Target	Methods	Effort per offset area[2]	Frequency	Season
Swift Parrot	Targeted searches in suitable habitats[1]	1 day per season	Annually	Autumn/Winter[3]
Corben's Long-eared Bat	Harp trapping[4]	8 trap nights over 2 nights[5]	Annually	Spring/Summer
Nest boxes	Inspection camera	Each nest box monitored at least once every five years	Annually	Spring
Salvaged woody debris	Herpetological search	30 minute active search	Annually	Spring

Notes: 1) Targeting areas of heavily flowering eucalypts. 2) Offset Area refers to Eastern Offsets (Braefield BOA, Sunshine BOA, Nioka North BOA), Central Offsets (Malle BOA, Myall Plains BOA, Wirrilah BOA, Goonbri BOA), Namoi Offsets (Namoi BOA, Jerralong BOA), Western Offsets (Merriendi BOA). 3) Key foraging resources for Regent Honeyeater and Swift Parrot in the Boggabri locality is the winter flowering *Eucalyptus albens* (White Box). Therefore, as far as reasonably practicable, surveys will be undertaken annually to coincide with BirdLife Australia's National Regent Honeyeater and Swift Parrot Survey periods in May and August. 4) Corben's Long-eared Bat cannot be identified from echolocation call alone and trapping is required to confirm the presence of this species. 5) Minimum harp trapping effort in the Western Offsets is 4 trap nights.

Targeted Regent Honeyeater and Swift Parrot surveys

Blossom nomads, such as the Swift Parrot and Regent Honeyeater do not reside in discrete areas, because their home range encompasses all the resources they require to survive. Due to variations in the distribution of blossom from year to year their distribution may shift from the western slopes to the coast or tablelands with different areas in each of these regions used as the blossoming interval of different tree species cycle.

Both the Regent Honeyeater and Swift Parrot are relatively cryptic species; with Swift Parrots blending too easily into canopy foliage and Regent Honeyeaters relatively quiet and so not standing out easily for bird surveyors to pick up.

Therefore, survey methodologies for these species, rely heavily on observing the distribution of blossom resources and other indicators, such as the occurrence of high nectarivorous bird densities and diversity to suggest their likely presence.

With the ecology of the birds and associated nectarivorous species in mind, surveys conducted within the BOA's will concentrate on patches of tree species, which the birds are likely to use. During the winter period when Swift Parrots are present on the mainland, the key nectar producing tree species in the Boggabri area is White Box *Eucalyptus albens*.

Therefore, surveys will involve checking White Box patches throughout the BOAs for the presence of blossom and nectarivorous bird activity to determine the likelihood that Swift Parrots and Regent Honeyeaters might be present locally.

Where blossom and nectarivorous bird densities are detected as being elevated opportunistic surveys in combination with formal 20 minute surveys would be conducted to detect the presence of Swift Parrots or Regent Honeyeaters.

Corben's Long-eared Bat surveys

Like other Long-eared Bat species Corben's Long-eared Bat (*Nyctophilus corbeni*) uses understorey strata for foraging and they roost in hollow-bearing trees.

Although many microchiropteran bat species are detectable through use of Anabat call detection methodologies, the differences between Nyctophilus spp. are too subtle to reliably differentiate between the various species occurring in the locality of the BOAs. Therefore, surveys for Corben's Long-eared Bat need to be conducted with a methodology that enables bats to be identified in the hand.

Harp traps are excellent for capture and release of microchiropteran bats and they are well suited to the capture of Nyctophilus spp. due to their propensity to use lower forest strata for their foraging habits.

Site selection for the setting of harp traps will include a number of rationale, including, targeting of those areas where Nyctophilus spp. had been detected during other monitoring programs and where suitable flyways were detected in forest and woodland areas.

Harp traps are to be set at each location over a two-consecutive night period.

Nest box monitoring

Monitoring will occur following the installation of nest boxes within the BOAs. A selection of nest boxes (i.e. Eastern, Central, Namoi and Western Offsets) would be nominated for monitoring in a particular year, with each nest box monitored at least once every five years.

Monitoring will be achieved using a pole-mounted inspection camera to remove the need for working at height with ladders. The camera would be operated entirely from the ground to approximately 6 m in height. Nest boxes would be monitored for signs of use (i.e. inhabitants, nesting material, chew/scratch marks, feathers/fur) and structural condition, and as far as practicable, would be monitored at consistent times of the year, which preferably is spring.

The following information will be recorded:

- Name of observer
- Date
- Prevailing weather conditions
- Nest box number/identification
- Nest box type
- Host tree species and diameter at breast height (DBH)

- Nest box height
- Nest box orientation
- Assessment of nest box condition (including photograph where necessary)
- Evidence of use (photograph using pole-mounted inspection camera)
- Presence of pest activity.

Salvaged woody debris monitoring

Monitoring will occur following the augmentation of habitat restoration zones with salvaged woody debris. Replicate monitoring sites would be selected based on the distribution of material within each offset area and incorporated into this monitoring program. Monitoring sites would be sampled for 30 person minutes within an approximate 1 ha area (~56 m radius) on each of two separate days.

7.2.1.2 Timing and frequency of BOA monitoring

To enable scientific and statistical robustness and to minimise the effects of temporal variation, the BOA monitoring program should be undertaken in spring. For consistency with the Leard Forest Regional Biodiversity Strategy (Stage 2 – Strategy Report) (Umwelt (Australia) Pty Limited 2017), replicate monitoring sites consistent with White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland (EEC/ CEEC) require additional vegetation sampling (transects and quadrats) in autumn.

The survey methodologies described in Section 7.2.1.1 (specifically, vegetation transects and quadrats, and general vertebrate survey methodologies) will be used to monitor the BOAs annually for five years, up to and inclusive of the year 2022. From the year 2023, monitoring of the BOAs may be considered biennially. It is noted however that targeted surveys for Regent Honeyeater, Swift Parrot and Corben's Long-eared Bat are a requirement of the Project's EPBC Approval (EPBC 2009/5256) and must be completed annually (unless otherwise agreed in writing by the Department of Environment and Energy).

7.2.2 Annual BOA inspections

The BOA's will be inspected by undertaking a visual assessment of a sample of each the BOA's each year to detect:

- maintenance requirements (e.g. fencing, signage and access tracks)
- disturbance factors including fire and unauthorised access (e.g. fire wood collection)
- presence of weeds and pests
- grazing pressure from over-abundant native herbivores
- areas requiring thinning and erosion management
- assessment of fuels loads and requirements for strategic grazing or control burns.

7.3 Performance and completion criteria

Under Condition 49(d) of the Project Approval, performance and completion criteria for the evaluation of the performance of the biodiversity offset strategies is required. The completion criteria for highly degraded areas are to be "trending towards benchmark condition". Benchmark conditions refer to either BBAM (2014) benchmarks, Biodiversity Assessment Methodology (BAM) (2016) benchmarks and/or appropriate monitoring analogue reference sites representative of each vegetation type as outlined in Table 2.3 of the Leard Forest Regional Biodiversity Strategy (Stage 2 – Strategy Report) (Umwelt (Australia) Pty Limited 2017). Replicate monitoring sites in the BOAs where established in accordance with BBAM (Office of Environment and Heritage 2014). Therefore, to ensure consistency, the benchmarks used to assess completion of performance criteria will include:

- BBAM (2014) benchmarks – used to analyse vegetation attributes such as native species richness; strata foliage cover and recruitment; structural characteristics such as hollow-bearing tree and woody debris density per hectare
- Long-term replicate monitoring sites associated with annual Leard State Forest monitoring (as described in 7.1.1 and illustrated in Figure 7.1) will be employed as analogue reference sites to determine locality specific fauna species richness/ abundance benchmarks.

Detailed management actions and performance criteria have been prepared for biodiversity management within the Project Boundary and BOAs (Table 7.6) as well as for threatened species and communities in the BOAs (Appendix F).

Objectives to complete the performance and completion criteria have been separated into the following three broad timeframes:

- Short-term – 0 to 5 years
- Medium-term – 5 to 15 years
- Long-term - >15 years.

Table 7.6 below summarises the performance and completion criteria for biodiversity management within the Project Boundary and BOAs.

Table 7.6 Performance and completion criteria for the management of biodiversity values within the Project Boundary and BOAs

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
Biodiversity management within Project Boundary				
Objective 1 — rehabilitation and revegetation within the Project Boundary	Project Boundary	Specific indicators to be within benchmark criteria or equal to the values obtained from the analogue site under the same set of conditions or show positive trend toward target values in order to demonstrate rehabilitation success or progression towards rehabilitation success (refer to RMP for more details).	Annually as part of the Annual Environmental Management Report as well as mine rehabilitation and Leard State Forest Biological Monitoring programs (refer Section 7.1.3 and Section 7.1.1 respectively).	Short to long term - to be confirmed as part of the Final Void and Mine Closure Plan to be prepared in 2025.
Objective 2 — habitat augmentation and nest box installation	Project Boundary	Salvaged resources that are reused or relocated in mine rehabilitation areas are in structurally good condition. 80 % of nest boxes installed are being utilised or show signs of use by native species. Each nest box installed should be in good structural condition. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded.	A selection of nest boxes would be nominated for monitoring in a particular year, with each nest box monitored at least once every five years.	Ongoing – long term
Objective 3 — maximising salvage and beneficial use of resources	Project Boundary	Salvage targets calculated and met using the Clearing and Fauna Management Procedure for fallen timber and natural hollows during tree clearing events (refer Section 6.1 and Appendix B). Maps of the salvage pile sites to be produced and included within Tree Clearing Report. The habitat resources are relocated to the rehabilitation and BOAs, preferably to be located within proximity to existing monitoring plots for ease of monitoring. Photographic evidence and documentation of habitat features salvaged and reused in rehabilitation areas, BOAs and fauna translocation sites to be collected and included in each Annual Review (where applicable).	After each tree clearing event. Tree Clearing Reports produced to verify that the salvage of habitat resources has occurred during clearing operations, in accordance with the Clearing and Fauna Management Procedure (Appendix B). Progress and effects of salvaging and reusing habitat resources are monitored and reported as part of the Biodiversity Monitoring Program and Annual Review (where applicable).	Short to medium term – ongoing until completion of final clearing event and all salvaged resources relocated.
Objective 4 — conserving and reusing topsoil and subsoils	Project Boundary	Topsoil and subsoil management undertaken in accordance with the Soil Management Protocol and RMP (refer to RMP and Appendix C of the Soil Management Protocol.	Annual Environmental Management Report.	Short to long term – ongoing until completion of clearing operations and rehabilitation areas are complete.
Objective 5 — protecting vegetation and soil outside the disturbance areas (minimising disturbance)	Project Boundary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to acknowledge clearing limits as well as necessary procedures and clearing limits and activities.	Annually following tree clearing events. Tree Clearing Report and Annual Environmental Management Report (when applicable) will supply tree clearing and survey data to verify.	Short to long term – ongoing.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
Objective 6 — investigate the development of a translocation and or propagation plan for *Tylophora linerais*	Project Boundary and BOAs	Consultation undertaken with DP&E and Maules Creek Coal Mine on the translocation and or propagation plan for the species. Translocation and propagation of *Tylophora linearis* undertaken in accordance with the Translocation and Propagation Management Plan (Appendix L). Investigations and consultations regarding the Translocation and Propagation Management Plan (Appendix L) included in the Annual Review.	Annually or as required during and after clearing operations in accordance with *Tylophora linearis* Translocation and Propagation Management Plan (Appendix L). Annually reviewed as part of Annual Environmental Management Report and Tree Clearing Report.	Short to medium term – aim to commence program 2019 however this is dependent on locating *Tylophora linearis* in bud within clearing footprint and therefore subject to change.
Objective 7 — managing the impacts of salinity on biodiversity	Project Boundary and BOAs	Successful rehabilitation of areas identified as being affected by salinity (where applicable) in accordance with Section 7.1. Water storage is constructed on site to detain water infiltration and allow for the reuse of rainwater. Unregulated discharge of saline water from the site into the receiving environments is prevented.	Annually as part of the Annual Environmental Management Report and Mine Rehabilitation Biodiversity Monitoring Report.	Short to long term – ongoing.
Objective 8 — pre-clearing surveys	Project Boundary	Tree clearing operations conducted in accordance with the pre-clearing checklists in the Clearing and Fauna Management Procedure (Appendix B).	Annually following each tree clearing event. Tree Clearing Reports will include completed pre-clearing checklists and relocation data.	Short to medium term - ongoing until completion of final clearing event.
Objective 9 — managing impacts on native fauna	Project Boundary	Tree clearing operations conducted in accordance with the pre-clearing checklists in the Clearing and Fauna Management Procedure (Appendix B).	Annually following each tree clearing event. Tree Clearing Reports will include completed pre-clearing checklists and relocation data.	Short to long term - ongoing.
Objective 10 — collecting and propagating seed	Project Boundary & BOAs	Seed is collected from a range of sites across the locality to capture local variations within both the BOAs and Project Boundary in accordance with relevant guidelines. Seed collection records including endorsements listed under Objective 1, location of plantings and success rates documented.	After each seed collection event. Seed collection report to be completed and included in each Annual Environmental Management Report (where applicable).	Short to medium term – ongoing.
Objective 11 — controlling weeds and feral animal species	Project Boundary	Records of noxious and priority weed observations, pest observations, treatment, and disposal are documented and included where applicable in the Annual Review. Increases in weed and pest densities within properties adjoining the Project Boundary are monitored in consultation with relevant land managers and stakeholders within the locality. The progress and effects of weed and pest management activities is monitored and reported annually as part of the Biodiversity Monitoring Program.	Annually as part of Annual Environmental Management Report and Biodiversity Monitoring Programs. Reports to include weed records, trends and issues.	Short to long term - ongoing.
Objective 12 — managing grazing and agriculture	Project Boundary	Livestock are progressively excluded from rehabilitation areas in the Project Boundary. Livestock restricted to designated grazing lands deemed suitable for weed management. Livestock grazing not negatively impacting on native species diversity and covers as determined by Annual Biodiversity Monitoring Program.	Annually as part of Annual Environmental Management Report and Biodiversity Monitoring Programs.	Short to medium term – ongoing.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
Objective 13 — controlling access	Project Boundary	Signage is maintained in good legible condition. Designated access roads and tracks are maintained.	Annually as part of Annual Environmental Management Report.	Short to long term - ongoing.
Objective 14 — minimising impacts to biodiversity, including threatened species	Project Boundary	All Project personnel are inducted, and induction records are maintained in the Boggabri Coal Mine database. Tree clearing operations undertaken in accordance with Clearing and Fauna Management Procedure (Appendix B). Project operations comply with the Weed and Pest Management Strategy (Appendix C). If threatened species identified, which has not been previously recorded, consultation with OEH and/or DoEE is undertaken.	During each site induction and reported annually as part of the Annual Environmental Management Report, Tree Clearing Report and Biodiversity Monitoring Program. Reports to include results of annual monitoring, tree clearing operations and consultation with regulatory authorities to verify efforts to minimise impacts to biodiversity.	Short to long term – ongoing.
Objective 15 — bushfire management	Project Boundary and BOAs	No accidental fires attributed to the Project occur. Assistance and consultation was given when required to the rural fire service or adjoining landholders if concern was raised or if fire risk was considered to be high.	Annually as part of Annual Environmental Management Report.	Short to long term – ongoing.
Objective 16 — protecting a vegetated corridor between the Project and the Maules Creek Coal Project	Biodiversity Corridor	Biodiversity Corridor boundaries to be delineated and signage is maintained in good legible condition Biodiversity Corridor Plan performance criteria met or on a trending towards being met. Cooperation with representatives of the Maules Creek Coal Mine on matters regarding biodiversity management within the vegetated buffer. Weed and pest control measures implemented to prevent and manage edge effects in accordance with Weed and Pest Management Strategy (Appendix C). Records of noxious weed observations, pest observations, treatment, and disposal are included in Annual Reviews where applicable.	Annually as part of Annual Environmental Management Report and Biodiversity Corridor Monitoring Report. Records of consultation, weed/pest observations, control measures and performance against Biodiversity Corridor Plan included in the Annual Environmental Management Report (where applicable).	Short to long term – ongoing.
Objective 17 — an integrated approach to biodiversity management	Project Boundary	Management measures are planned and implemented consistently within the rehabilitation sites, surrounding areas within the Project Boundary and BOAs.	During reviews of management plans to ensure integrated approach.	Short to medium term – ongoing.
Objective 18 — limiting vegetation clearing to a staged approach	Project Boundary	BCOPL has not cleared more than the maximum Boggabri Project Boundary disturbance limits specified for each of the years 5, 10, 15 and 21, unless otherwise approved in writing by the Minister.	Reviewed following tree clearing operations years 5, 10, 15 and 21. Results of review included in the Annual Environmental Management Report as required.	Short to medium term - ongoing until completion of final clearing event.
Objective 19 — erosion control	Project Boundary	Sources of erosion are reported when identified and the control measures in the RMP are considered to minimise erosion within the Project Boundary and BOAs. Capture of sediment within the Project Boundary is undertaken using the approved sediment control measures (i.e. silt fences and other measures detailed in the RMP).	Annually as part of Annual Environmental Management Report details of erosion and sediment observations and control measures implemented are provided where applicable.	Short to long term - ongoing.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
Objective 20 — potential cultural heritage values conflicts	Project Boundary	Salvage of archaeological finds within the Project Boundary and BOAs is undertaken as described in the CHMP. All incidental finds of cultural heritage items are managed as per the due diligence guidelines in the CHMP.	Annually as part of Annual Review details of cultural heritage items found within Project Boundary and BOAs will be provided where applicable.	Short to long term - ongoing.
Objective 21 – restoration of understorey clearing outside the mine disturbance limit	Project Boundary	Area of understorey clearing outside the mine disturbance limit in February 2014 not disturbed and allowed to naturally regenerate. Area of understorey clearing outside the mine disturbance limit in February 2014 monitored on an annual basis as part of the Leard State Forest Biological Monitoring program in accordance with BBAM 2014. Native species richness and cover and structural attributes of area cleared meet at least 80% of BBAM benchmark criteria for corresponding vegetation type within 10 years of clearing event. If 80% of benchmark is not met within 10 years, following clearing event, active restoration measures are undertaken to assist regeneration.	Annually as part of Annual Environmental Management Report and Annual Leard State Forest Biological Monitoring Program.	Short to medium term – ongoing.
Biodiversity management within the BOAs				
Natural regeneration	Habitat Restoration Zone	100% of Box Gum Woodland BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting for example *Eucalyptus albens* and/or *Eucalyptus melliodora*. Given monitoring is undertaken in accordance with BBAM 2014 sampling for natural regeneration is to occur across the entire vegetation zone. Further management actions may be required if natural regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in Habitat Restoration Zones after five years, supplementary planting of canopy species (i.e. active regeneration) would commence at a density approximate to BBAM 2014 benchmarks. Naturally regenerated areas of Box Gum Woodland conform to condition assessment outlined on page five of the EPBC Policy Statement 3.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands within the Habitat Restoration Zones. 100% of Box Gum Woodland within Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in 7.1.1 and illustrated in Figure 7.1). 100% of Box Gum Woodland BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. If the targets above for Box Gum Woodland are not met by year 10 active regeneration has commenced.	Annual monitoring of vegetation attributes in accordance with BBAM 2014 at each BOA Box Gum Woodland monitoring location. Annual monitoring of fauna usage in accordance with monitoring methodology detailed in 7.2.1.1 (specifically general vertebrate survey methodologies) Monitoring of natural regeneration across management zones on a five yearly basis to determine whether active revegetation is required. Monitoring results to be provided within Biodiversity Offset Area Monitoring Report and Annual Environmental Management Report.	Short to medium term – by year 10.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
		Naturally regenerated areas to be managed to encourage a range of fauna habitats to encourage use by a variety of fauna species (for example open woodland, grassland areas, shrubby woodland, allow for uptake of mistletoe species etc.) as described in Appendix F.		
Collect and propagate seed	All management zones	Refer to Objective 9 above for specific performance measures and competition criteria.	After each seed collection event. Seed collection report to be completed and included in each Annual Environmental Management Report (where applicable).	Short to medium term – ongoing.
Active revegetation	Habitat Management Zones and Corridor Enhancement Zones	100% of Box Gum Woodland at BOA monitoring locations within the Habitat Restoration Zones show locally occurring canopy species recruiting for example *Eucalyptus albens* and/or *Eucalyptus melliodora*. Given monitoring is undertaken in accordance with BBAM 2014 sampling for natural regeneration is to occur across the entire vegetation zone. Actively revegetated areas of Box Gum Woodland conform to condition assessment outlined on page five of the EPBC Policy Statement 3.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands within the Habitat Restoration Zones. 100% of Box Gum Woodland within Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in 7.1.1 and illustrated in Figure 7.1) following active revegetation. 100% of Box Gum Woodland BOA monitoring sites within Habitat Restoration Zones area within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark following active revegetation. Actively revegetated areas to be managed to encourage a range of fauna habitats to encourage use by a variety of fauna species (for example open woodland, grassland areas, shrubby woodland, allow for update of mistletoe species etc.) as described in Appendix F.	Annually monitored following active revegetation in accordance with biodiversity monitoring procedure detailed in 7.2.1.1. Monitoring results to be provided within Biodiversity Offset Area Monitoring Report and Annual Environmental Management Report.	Medium to long term: Criteria 1 & 2 - by year 15. Criteria 3 & 4 – by year 20.
Restoration of native grasslands derived from Box Gum Woodland (DNG)	Habitat Restoration Zones	At least 350 ha of Box Gum Woodland DNG across all BOAs are actively being restored back to Box Gum Woodland (refer to BOS and Appendix E for locations and areas of Box Gum Woodland DNG to be restored). Natural regeneration and active revegetation performance and completion criteria identified above have been met. Active revegetation to commence within 10 years of control measures being implemented (refer to Figure E-32 of Appendix E for indicative revegetation program across the BOAs). Survival rate of revegetation (i.e. tubestock planting) at least 80% after five years following planting event (taking into consideration drought and seasonal conditions). Where 50% is not achieved supplementary tubestock planting or direct seed is completed. Nest boxes incorporated into restoration areas until natural regeneration of tree hollows predominate. Nest box installation to occur in accordance with Table F-7 (Appendix F). 100% of nest boxes installed within 15 years of offset establishment.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report.	Short to long term – ongoing.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
Long-term maintenance of Box Gum Woodland	All management zones	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five. Annual biodiversity monitoring undertaken in accordance with Section 7.2 to measure the success of restoration and maintenance of Box Gum Woodland against BBAM 2014 benchmark data and analogue sites within Habitat Management Zones. Monitoring to include photograph point monitoring.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report.	Short to long term – ongoing.
Salvage of habitat resources	Project Boundary, rehabilitation areas and BOAs	Salvaged resources (as detailed in Objective 3 above) are reused and relocated to rehabilitated areas and BOA Habitat Restoration Zones and are in structurally good condition.	Annually following placement of salvaged resources.	Short term – by year five following placements of salvaged resources.
Provision of artificial/ supplementary habitat suitable for breeding i.e. habitat augmentation and nest box installation	Habitat Restoration Zone	A nest box procedure would be developed for each offset area (Eastern, Central, Namoi and Western) five years following commencement of active restoration. 50% of nest boxes installed from a rehabilitation age of 10 years, or once regenerating canopy species are commensurate with criteria detailed in Appendix F, where practicable. 100% of nest boxes (remaining 50%) incorporated from a rehabilitation age of 15 years, or once regenerating canopy species are commensurate with criteria detailed in Appendix F. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.	A selection of nest boxes (i.e. Eastern, Central, Namoi or Western Offsets) would be nominated for monitoring in a particular year, with each nest box monitored at least once every five years.	Short to long term – ongoing.
Access control for the protection of existing habitats	All management zones	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas. Appropriate wildlife fencing installed and/or maintained around BOA boundaries, where appropriate. Appropriate locks and signage is maintained in good legible condition and designated access roads and tracks are maintained in order to prevent unauthorised access.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report.	Short to long term – ongoing. Fences installed by year 10 and maintained as required.
Maintenance, enhancement and restoration of fauna habitat and habitat usage	All management zones	Annual monitoring of diurnal bird and microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Habitat Management Zones show no observed significant decrease (i.e. greater than 40 % reduction sustained over three consecutive sampling periods) in bird species richness across the BOAs that cannot be attributed to natural variation against baseline monitoring site data.	Annually as part of Annual Environmental Management Reportand Biodiversity Offset Area Monitoring Report.	Short to long term - ongoing. Habitat Management Zones – five years. Habitat Restoration Zones and Corridor Enhancement Zones - >10 years.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
		Habitat Restoration Zones and Corridor Enhancement Zones show an observed increase in bird species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in 7.1.1 and illustrated in Figure 7.1). Threatened bird species occupancy and habitat usage continues. Salvaged resources are reused and relocated to BOA Habitat Restoration Areas and are in structurally good condition.		
Weed and pest communication and control	All management zones	Weed trends and control schedules communicated across within other coal mines within the locality as required (i.e. Tarrawonga Coal Project and Maules Creek Coal Project). Annual BOA Biodiversity Monitoring Report provides annual summary report of weed and pest information including records on trends and issues where required. Key weed and pest issues effectively communicated to other coal mines, relevant land owners, managers and other stakeholders as required.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report. Reports to include summary of weed and pest records, trends and issues and provided to other coal mines and stakeholders within the locality as required.	Short to long term – ongoing.
Weed prevention and control	All management zones	Annual BOA Biodiversity Monitoring Report shows an overall reduction in exotic plant cover following implementation of control measures across all BOAs. Weed species within native vegetation communities comprise less than 20% of any strata across the BOAs within 10 years of control measures being implemented. Cypress Pine and Shiny Bush thinning undertaken across BOAs. Endeavour to achieve the following targets: Reduced to less than 80% of original distribution by end of year 5 Reduced to less than 50% of original distribution by end of year 10 Reduced to less than 30% of original distribution by end of year 15 Maintenance thinning to occur in years following initial thinning events. Weed control undertaken in accordance with the relevant practises and guidelines specified in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new weed infestations are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification, where applicable.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report. Reports to include summary of weed records, trends and issues and provided to other coal mines within the locality as required.	Short to long term – ongoing.
Pest prevention and control	All management zones	Annual BOA Biodiversity Monitoring Report shows an overall reduction in pest animal species and population sizes targeted by control measures implemented across all management zones across all BOAs (taking into consideration potential drought conditions and seasonal trends). Pest animal control is undertaken in accordance with relevant Codes of Practise and Standard Operating Procedures as detailed in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new pest occurrences are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification, where applicable.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report. Reports to include summary of pest records, trends and issues and provided to other coal mines within the locality as required.	Short to long term ongoing. Annual biodiversity monitoring shows overall reduction in pest animals within five years of control measures being implemented.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
Management of fuel loads and implementation of appropriate fire regime for conservation	All management zones	Strategic grazing is implemented in the appropriate management zones to reduce fuel loads if deemed suitable following monitoring recommendations or as recommended by NSW Rural Fire Service. Controlled burns are used to manage fuel loads (as per management actions detailed in Section 6.2) as deemed necessary and in consultation with the NSW Rural Fire Service. Impacts of controlled and mosaic burns within across the BOAs on native and weed species diversity if documented and made available to other coal mines within the locality (i.e. Tarrawonga Coal Project and Maules Creek Coal Project). Records to include information on location, intensity and time period burn was undertaken. Access tracks and fire breaks maintained in accordance with Section 6.2 and in consultation with NSW Rural Fire Service, as required.	Crash grazing to be implemented where identified during BOA monitoring as bring required or as recommended by NSW Rural Fire Service. Review of crash grazing requirements to occur every two years. Requirements to use control burns to reduce fuel loads will be investigated every five year. Control burns to occur as required in accordance with Section 6.2. Monitoring of control burns to occur within a year after each burn event.	Short to long term – ongoing as required.
Nutrient management	Habitat Restoration Zone	Nutrient loads are reduced across all BOAs i.e. all fertilisers and other soil amelioration measures associated with agriculture have ceased and livestock grazing excluded. Only soil improvement measures and crash grazing required for revegetation/regeneration as well as fuel load and weed management of native vegetation communities to occur. Annual BOA Biodiversity Monitoring Report shows an overall reduction in weed species (such as broadleaf weeds and annual pasture grasses) following reduction of fertiliser use across all BOAs. Weed species within native vegetation communities comprise less than 20% of any strata across the BOAs.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report. Reports to include summary of measures undertaken to reduce nutrient loads and success of this by providing weed records, trends and issues.	Short term – prior to revegetation and regeneration works commencement.
Mine rehabilitation and vegetated buffer corridor for habitat connectivity	Mine rehabilitation area and edge of Project Boundary	Rehabilitated habitat within the mine rehabilitation areas and BOAs as well as the vegetated buffer corridor provides a wildlife corridor linking habitat from conservation areas in the east, through Leard State Forest and to the west towards the Namoi River.	Annually following rehabilitation as part of the Annual Environmental Management Report, Mine Rehabilitation Area Monitoring Report, Biodiversity Corridor Monitoring Report and BTM Complex Summary Report.	Short to long term – by year 30 (subject to relinquishment of mining lease).
Connectivity to landscapes and broader regional corridors	All management zones	BOA corridor weed and pest management and control is undertaken in accordance with the Weed and Pest Management Strategy (refer Appendix C) and meet all performance and completion criteria detailed above in the following BOA objectives: Weed and pest communication and control Weed prevention and control Pest prevention and control. Targeted fauna monitoring indicates that the BOAs provide habitat for native fauna species within the locality (as per monitoring methods detailed in Section 7.2.1.1).	As per timing outlined above in weed and pest management objectives. Native fauna utilisation will be monitored annually following rehabilitation as part of the Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report.	Short to long term – ongoing. Native fauna utilisation by year 10.
Monitoring of overall ecosystem health and structure	All management zones	Annual biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table.	Annually as part of Biodiversity Offset Area Monitoring Report and Annual Environmental Management Report.	Short to long term – ongoing.

Objective	Management zone	Performance and completion criteria	Timeframe	
			Ongoing performance measured/monitored	Completion
		Native vegetation communities within BOAs met at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.		
Biodiversity management consultation	All management zones	Targeted consultation with key stakeholders, land managers and relevant government authorities regarding biodiversity issues is demonstrated through the development of resources and workshops. A summary report is prepared detailing overall biodiversity performance and outcomes across the BTM Complex.	Annually as part of Annual Environmental Management Report and Biodiversity Offset Area Monitoring Report. BTM Complex summary report to be completed annually detailing overall biodiversity performance and outcomes of the offset sites across the region.	Short to long term – ongoing.

Notes: 1. Habitat Management Zone, Habitat Restoration Zone, Corridor Enhancement Zone and Other Land for Agriculture Zone.

Table 7.7 BBAM 2016 vegetation attribute benchmarks for habitat restoration areas

Vegetation community	Native species richness	Native over-storey % cover		Native mid-strorey % cover		Native groundcover % cover						No. of trees with hollows	Total length of fallen timber
						Grasses		Shrubs		Other			
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper		
White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (NA226)	23	6	25	0	5	30	40	0	0	3	5	1	30
Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (NA237)	23	6	25	0	5	30	40	0	0	3	5	1	30
Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (NA197)	25	6	25	0	5	30	40	3	10	3	5	1	15
Weeping Myall open woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions (NA225)	20	6	25	0	5	20	30	0	0	3	5	1	15
River Red Gum riverine woodlands and forests in the Nandewar and Brigalow Belt South Bioregions (NA193)	28	25	40	3	25	20	30	0	0	3	5	2	20
Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams mainly of the temperate (hot summer) climate zone (NA179)	30	25	40	6	25	20	30	3	10	3	5	2	20
White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228)	30	25	40	6	25	20	30	3	10	3	5	2	20
White Cypress Pine - Silver-leaved Ironbark - Tumbledown Red Gum shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA229)	30	25	40	6	25	20	30	3	10	3	5	2	20
Dwyer's Red Gum woodland on siliceous substrates in the Brigalow Belt South Bioregion (NA138)	30	25	40	6	25	20	30	3	10	3	5	2	20
White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA225)	26	6	25	6	25	20	30	3	10	3	5	1	15

Source: OEH Vegetation Classification Information System {Office of Environment & Heritage, 2016 #7195}

7.4 Trigger Action Response Plan

A Trigger Action Response Plan (TARP) is a tool which provides a threshold or 'trigger' of a variable. When the trigger is observed during monitoring it indicates that additional actions are required to rectify a problem. A TARP, based on the Leard Forest Regional Biodiversity Strategy Stage 2 – Strategy Report, for all the BOAs is provided below in Table 7.8.

Table 7.8 BOA Trigger Action Response Plan

Variable	Trigger	Action and response
Natural regeneration	n Canopy species not recruiting across 100% of Habitat Restoration Zones after five years following offset establishment. n Naturally regenerated areas to not conform to the definition of Box Gum Woodland in the EPBC Policy Statement 3.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands after 10 years following offset establishment.	n Investigate likely reasons for failure via review of successful naturally regenerating areas. n Implement appropriate supplementary plantings (i.e. active revegetation) and consider targeted removal of non-characteristic species and weeds, following supplementary planting, if deemed required. n Consider additional monitoring to examine the establishment and success of active revegetation i.e. tubestock planting and direct seeding.
	n Naturally regenerating Box Gum Woodland DNG regenerating into vegetation community other than Box Gum Woodland.	n Undertake consultation with OEH on whether actions are required. n If required, targeted removal of non-characteristic species, followed by supplementary planting with characteristic species (i.e. tube stock planting and direct seeding). n Consider additional monitoring to examine progress of areas regenerating to Box Gum Woodland. n
	n Native fauna species do not show at least 80% evidence of occupation or presence across 100% of Habitat Restorations Zones after 10 years following offset establishment.	n Investigate likely causes of failure and develop strategy to prioritise habitat argumentation of habitat resources such as salvaged timber and nest box installation for targeted threatened and locally occurring species.
	n Vegetation cover scores within all Habitat Restoration Zones do not meet or are not within BBAM 2014 benchmark values for Box Gum Woodland after 10 years following offset establishment. n Native species richness within all Habitat Restoration Zones do not meet at least 80% of the BBAM 2014 benchmark value for Box Gum Woodland after 10 years following offset establishment.	n Investigate likely reasons for below benchmark performance via review of successful naturally regenerating areas. n Undertake consultation with OEH on whether actions are required. n Determine whether supplementary tubestock planting and/or direct seeding is required to increase vegetation attributes to benchmarks.
	n Naturally regenerating areas are not being managed to encourage a range of fauna habitats to encourage use by a	n Review of actively revegetated areas by ecologist to determine what management is required to encourage a variety of fauna habitats.

Variable	Trigger	Action and response
	variety of fauna species (for example open woodland, shrubby woodland etc.).	n Management identified is implemented and monitored as part of annual biodiversity monitoring.
Collect and propagate seed	n Seed collection records are not reported within Annual Review.	n Make appropriate notations in the Annual Summary Report on environmental documentation performance.
	n Seeds cannot be sourced within the locality due to environmental influences such as drought or disease.	n Review available seed sources and investigate whether appropriate seed from bordering localities/regions are available for use.
	n Seed is not collected over a range of sites across the locality and variations in seed mixes are not captured.	n Review seed inventory and propagated plants and investigate where there is a need to collect seed from other areas. n Review the success, trends of failure of rehabilitation/revegetation that has occurred to date using seed and tubestock to determine whether greater diversity is required. n Seed tested annually for viability. n Where greater diversity is required

Variable	Trigger	Action and response
Active revegetation	n Canopy species not recruiting across 100% of Habitat Restoration Zones after 15 years following offset establishment. n Actively regenerated areas to not conform to the definition of Box Gum Woodland in the EPBC Policy Statement 3.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands after 15 years following offset establishment.	n Investigate likely reasons for failure via review of successful actively revegetated areas. n Consider targeted removal of n Implement appropriate non-characteristic species and weeds, following supplementary planting, if deemed required. n Consider additional monitoring to examine the establishment and success of active revegetation i.e. tubestock planting and direct seeding.
	n Native fauna species do not show at least 80% evidence of occupation or presence across 100% of Habitat Restorations Zones after 15 years following offset establishment.	n Investigate likely causes of failure and develop strategy to prioritise habitat argumentation of habitat resources such as salvaged timber and nest box installation for targeted threatened and locally occurring species.
	n Vegetation cover scores within all Habitat Restoration Zones do not meet or are not within BBAM 2014 benchmark values for Box Gum Woodland after 15 years following offset establishment. n Native species richness within all Habitat Restoration Zones do not meet at least 80% of the BBAM 2014 benchmark value for Box Gum Woodland after 15 years following offset establishment. n Survival rate of supplementary tubestock planting less than 80% after five years following planting event.	n Investigate likely reasons for below benchmark performance via review of successful naturally regenerating areas. n Undertake consultation with OEH on whether actions are required. n Determine whether additional supplementary tubestock planting and/or direct seeding is required to increase vegetation attributes to benchmarks. n Test seed annually for viability n Complete soil testing and if necessary, amelioration in poor performing areas. n Where 50% survival rate is not achieved review possible causes of failure (for example drought) and undertake

Variable	Trigger	Action and response
		additional supplementary planting as required to meet benchmark values.
	n Actively revegetated areas not managed to encourage a range of fauna habitats to encourage use by a variety of fauna species (for example open woodland, shrubby woodland etc.).	n Review of actively revegetated areas by ecologist to determine what management is required to encourage a variety of fauna habitats. n Management identified is implemented and monitored as part of annual biodiversity monitoring.
Severe or prolonged drought leading to widespread failure of revegetation	n Monitoring or vegetation assessments highlight inadequate ground cover and or paucity in species diversity/distribution	n Amelioration of dispersive soils where required during seeding/planting works to improve infiltration and water holder capacity n Control of grazing to minimize erosion, soil compaction and maintain soil surface cover n Targeted seeding/planting of impacted areas.
Restoration of native grasslands derived from Box Gum Woodland (DNG)	n Less than 350 ha of Box Gum Woodland DNG has been restored. n Natural regeneration and active revegetation triggers are not being met.	n Review restoration work areas and determine where additional restoration is required to ensure 350 ha is restored.
Long-term maintenance of Box Gum Woodland	n Fencing, signage, gates and locks not installed or not in good condition. n Annual biodiversity monitoring not undertaken in accordance with Section 7.2.2.2.	n Review existing infrastructure presence and condition and determine what is required to rectify the issue. n Review of biodiversity monitoring procedure and reporting template. Where appropriate update report to include required items. n Recommendations provided in report to be implemented as required to reach benchmark and performance criteria.
Salvage of habitat resources	n Salvaged materials are no longer present, have been damaged or have deteriorated.	n If appropriate, re-establish salvaged resources. n Review whether additional habitat resources require salvaging during future tree clearing operations to compensate for loss of resources in BOAs. n Review and identify the need to replace hollow loss with nest boxes. n Review and identify appropriate measures to reduce loss, damage or deterioration of salvaged resources in the future.

Variable	Trigger	Action and response
Provision of artificial/ supplementary habitat suitable for breeding i.e. habitat augmentation and nest box installation	n Loss or damage of nest boxes and/or deterioration of nest box condition.	n Identify and replace all lost or damaged nest boxes. n Review and identify appropriate measures to reduce loss, damage and deterioration of nest boxes in the future.
	n Less than 80% of the nest boxes installed show evidence of use across BOAs after five years following installation.	n Review performance of nest boxes and naturally occurring hollows at reference sites to investigate whether alterations to nest box design, replacements or locations require change. Review current literature as required.
	n Nest boxes are no longer in good structural condition or found to be utilised by pest species such as European Honey Bee, Common Starlings or rodents.	n Remove pest species identified, as required. n Consider the need to replace or repair nest box.
Access control for the protection of existing habitats	n Livestock are accessing and causing damage to areas where they should be excluded. n Monitoring or vegetation assessments identify impact from grazing animals.	n Identify location and where entry has occurred and repair/alter fencing as required. n Destock areas identified as being affected by livestock grazing n Specifically, monitor livestock occupancy within conservational areas and areas where livestock has been found where they should have been excluded once identified n Pest control undertaken in accordance with Weed and Pest Management Strategy (Appendix C).
	n Reports of native wildlife being injured as a result of barbed wire on fences.	n Review and investigate incident(s) and advise on whether alternative fencing materials or fencing styles are required to reduce native fauna injury.
	n Locks, signage and access tracks in poor condition. n Reports of unauthorised access and illegal pest hunting occurring with BOAs	n Review incidents(s) and advise on whether additional methods are required to limit unauthorised access and to prevent damage to locks,
Damage to vegetation communities from erosion.	n Significant gully or tunnel erosion identified during monitoring.	n Target seeding/planting in high erosion risk areas where required n Monitoring of erosion condition and success / failure of erosion control measurements implemented n Appropriate treatment of identified erosion n Amelioration of dispersive soils during seeding/planting activities.

Variable	Trigger	Action and response
Maintenance, enhancement and restoration of fauna habitat and habitat usage	n Annual BOA monitoring indicates that there is an overall decrease (greater than 30 % reduction sustained over three consecutive sampling periods) in bird species richness/abundance that cannot be attributed to natural variation against benchmark data. n Absence of a range of habitat features across all management zones within BOAs being utilised by fauna species.	n Review fauna habitat utilisation and fauna habitat attributes which occur and investigate likely reasons for failure versus success. n Investigate the need for further habitat augmentation (such as relocation of salvaged fallen timber and installation of nest boxes) to provide and/or increase habitat within the BOA corridors. n Consider additional monitoring to examine the success of further habitat augmentation, as appropriate.
Weed and pest communication and control	n Weed trends and control schedules not communicated across within other coal mines, stakeholders and land managers within the locality as required (i.e. Tarrawonga Coal Project and Maules Creek Coal Project).	n BCOPL Environmental Superintendent responsible for making information available for meeting and forums as appropriate.
Impact of weeds and/or invertebrate pest animal leading to wide spread failure of revegetation ecosystems	n Monitoring or vegetation assessments identify increased weed competition or degradation by pest animal species	n Management of weeds and pest animals in accordance with the BMP, RMP and Weed and Pest Management Strategy (Appendix C) n Modification to seeding/planting techniques n Low intensity burning regimes where required to control weeds, manage nutrients in the biomass and trigger growth.
Weed prevention and control	n Annual BOA monitoring indicates that there is an overall increase in exotic plant cover following control measures implemented across all BOAs. n Weed species comprise greater than 20% cover of any strata cross all BOA native vegetation communities during any year following offset establishment. n Pine thinning targets are not met.	n Identify location of weed issues and review the need to implement additional or alternative control measures such a physical removal, herbicides, strategic grazing and/or control burns. n Consider additional monitoring to examine success or otherwise of additional control measures implemented. n Consider the potential impact of drought, high rainfall events and other seasonal trends when reviewing weed control and management.
	n Weed control is not undertaken in accordance with Weed and Pest Management Strategy (Appendix C).	n Review methods being used and consult with relevant authorities on whether there are other suitable control measures available. n Discuss alternative control methods with contractors hired to undertake weed control.

Variable	Trigger	Action and response
	n Significant weed invasions or newly identified weed significant species identified within BOAs during site inspections and biodiversity monitoring.	n Review issues and implement appropriate control measures within one year of identifying issue.
Pest prevention and control	n Annual BOA monitoring indicates that there is an overall increase in pest animal species following control measures implemented across all BOAs.	n Identify location of pest animal issues and review the need to implement additional or alternative control measures in accordance with Weed and Pest Management Strategy (Appendix C). n Consider additional monitoring to examine success or otherwise of additional control measures implemented. n Consider the potential impact of drought, high rainfall events and other seasonal trends when reviewing weed control and management.
	n Pest animal control is not undertaken in accordance with Weed and Pest Management Strategy (Appendix C).	n Review methods being used and consult with DPI on whether there are other suitable control measures available. n Discuss alternative control methods with contractors hired to undertake pest control.
	n Significant pest animal occurrences or newly identified pest species identified within BOAs during site inspections and biodiversity monitoring.	n Review issues and implement appropriate control measures within one year of identifying issue.
Management of fuel loads and implementation of appropriate fire regime for conservation	n Fuel loads are accessed as being moderate or high rick for intense and damaging fires as part of BOA inspections/NSW Rural Fire Service assessment.	n Undertake controlled burning as required in accordance with Section 7.2.1.4 and in consultation with NSW Rural Fire Service. n Consider implementation of strategic grazing in appropriate management zones identified with a moderate to high risk where control burns are not considered suitable.
	n Impacts of control and mosaic burning of weed and native species diversity is found to be detrimental. n	n Review fire regime implemented and investigate suitable actions and reinstate restoration activates as required. n Review and utilise most current control burning advice for Box Gum Woodland and fauna habitats. Update BMP and control measures as required.
	n Fuel reduction control burns not undertaken in accordance with Section 7.2.1.4.	n Review BOA monitoring reports and inspection reports to determine the level of fuel loads within the BOAs. Discuss whether control burns are an appropriate control measure

Variable	Trigger	Action and response
		with the NSW Rural Fire Service and adjacent land managers. n Review and utilise most current control burning advice for Box Gum Woodland and fauna habitats. Update BMP and control measures as required. n Consider implementation of strategic grazing in appropriate management zones identified with a moderate to high risk where control burns are not considered suitable.
	n Unplanned high intensity bush fire	n Inspection and maintenance of Asset Protection Zones n Active encouragement of staff involvement with the Rural Fire Services n Low intensity burning regimes where required to control weeds and fuel loads n Targeted seeding/planting of impacted areas.
Nutrient management	n Annual BOA monitoring indicates that there is an overall increase in exotic plant cover following control measures implemented across all BOAs. n Weed species comprise greater than 20% cover of any strata across all BOA native vegetation communities during any year following offset establishment.	n Identify location of nutrient issues and review the need to implement additional or alternative control measures such as alternative weed management methods. n Consider additional monitoring to examine success or otherwise of additional/alternative control measures implemented. n Consider the potential impact of drought, high rainfall events and other seasonal trends when reviewing nutrient management.
Mine rehabilitation and vegetated buffer corridor for habitat connectivity	n Mine rehabilitation areas and biodiversity buffer corridor does not provide linking habitat from conservation areas in the east, through to Leard State Forest and west towards the Namoi River after 30 years following the approval of the Leard Forest Biodiversity Regional Biodiversity Strategy Stage 2 – Strategy Report.	n Investigate the need for further habitat augmentation (such as relocation of salvaged fallen timber and installation of nest boxes) to provide and/or increase habitat within the BOA corridors. n Review the mine rehabilitation status (refer to RMP) and confirm whether supplementary canopy planting or other control measures are required. n Investigate opportunities to secure other land holdings which could increase habitat connectivity.

Variable	Trigger	Action and response
	n Do not demonstrate a coordinated approach to monitoring the vegetated biodiversity corridor.	n Undertake annual meeting with Maules Creek Coal Mine representatives to discuss and coordinate the vegetation biodiversity corridor.
Connectivity to landscapes and broader regional corridors	Weed and pest control is not undertaken in accordance with Weed and Pest Management Strategy (Appendix C) and as detailed in the following variables above: • Weed and pest communication and control • Weed prevention and control • Pest prevention and control.	n As per weed and pest communication and control, weed prevention and control and pest prevention and control variables above.
	Monitoring indicates that offset corridors to not provide habitat for native fauna species in the locality within 10 years following offset establishment.	n Investigate the need for further habitat augmentation (such as relocation of salvaged fallen timber and installation of nest boxes) to provide and/or increase habitat within the BOA corridors. n Consider additional fauna monitoring required to investigate fauna utilisation and movement within the BOA locality.
Monitoring of overall ecosystem health and structure	n Annual biodiversity monitoring is not undertaken in accordance with Section 7.2.2.2 and does not report on the health and structure of all management zones against relevant benchmarks and performance criteria.	n Review of biodiversity monitoring procedure and reporting template. Where appropriate update report to include required items. n Recommendations provided in report to be implemented as required to reach benchmark and performance criteria.
Biodiversity management consultation	n Targeted consultation with key stakeholders, land managers and relevant government authorities regarding biodiversity issues is not undertaken through development of resources and workshops. n Meetings have not included relevant authorities and agencies (i.e. OEH, DPE, LLS and NPWS) and Community Consultative Committee.	n BCOPL Environmental Superintendent responsible for invitations to be sent out to relevant parties with adequate lead time to allow appropriate parties to attend and/or engage in issues.

8. Reporting

Various reports regarding the management of biodiversity at the Boggabri Coal Mine will be prepared at regular intervals. These reports are discussed in detail below.

8.1 Environmental incident reports

All environmental incidents, complaints, non-conformance or exceedance of performance criteria as identified by annual monitoring or reporting will be managed as per the requirements of the BCOPL Environmental Incident Response Management Protocol.

8.2 Annual review report

BCOPL prepares and submits an Annual Review report to regulatory authorities as required by the Project Approval conditions. This report provides an assessment of environmental performance against the BMP and Project Approval conditions.

The Annual Review will be completed by the end of March each year.

The management of the BMP remains the responsibility of the Environment Superintendent.

8.3 Annual biodiversity monitoring reports

The Project Ecologist prepares and submits annual biodiversity monitoring reports to the BCOPL Environmental Superintendent to inform biodiversity issues, trends and performance for inclusion in the Annual Environmental Management Report. The biodiversity monitoring reports prepared include:

- Leard State Forest Biological Monitoring Report (for operational impacts of the Project on the surrounding environment)
- Biodiversity Corridor Monitoring Report
- Mine Rehabilitation Area Monitoring Report
- BOA Monitoring Report.

Biodiversity monitoring reports will be completed by February each year.

8.4 Annual tree clearing report

The Project Ecologist prepares and submits an annual Tree Clearing Report to the BCOPL Environmental Superintendent to verify that the salvage of habitat resources and tree clearing operation has been undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B). The annual Tree Clearing Report will inform the Annual Review.

8.5 Annual consultation summary report

The BTM Complex to prepare an annual consultation summary report detailing the overall biodiversity performance and outcomes of the mine rehabilitation and offsets across the BTM Complex. BCOPL to consult and liaise with other coal mines within the BMT Complex to aid in the preparation of this report.

8.6 BMP

8.6.1 Preparation

As with the preparation of other EMPs at the Boggabri Coal Mine, the development of this BMP and supporting strategies and procedures has been undertaken through a consultative approach (refer Section 1.4.2). Regulatory authorities and other key stakeholders engaged throughout this process include DoEE, DP&E, OEH, DRG, DPI, North West LLS and the CCC.

8.6.2 Review

A review of this BMP may be triggered as described in the Project Approval (Schedule 5, Condition 5) within 3 months of the following:

- annual review under Schedule 5, Condition 4 of the Project Approval
- incident report under Schedule 5, Condition 8 of the Project Approval
- audit under Schedule 5, Condition 10 of the Project Approval
- modifications to the Project Approval.

The BMP will be revised where necessary following a review of the document.

In addition to updates following the above noted milestones, Project Approval Schedule 3, Conditions 43 and 50 require that the BMP and Biodiversity Offset Strategy are revised within six months of the approval of Stage 2 of the Leard Forest Mining Precinct Regional Biodiversity Strategy.

As stated in Schedule 3, Condition 43 and 50 (Table 4.2) BCOPL has a responsibility to demonstrate consistency with the findings of the Leard Forest Regional Biodiversity Strategy (Umwelt 2017). As such, the management and monitoring framework within this BMP have been aligned to those detailed in Section 2.1 of the Leard Forest Regional Biodiversity Strategy to ensure consistency with other biodiversity conservation areas within the region. Specifically, the BMP has considered the following six strategic focus areas of the strategy:

- Strategic Focus Area 1 – Enhance the quality of habitats and landscapes at the offset sites for White Box – Yellow Box – Blakely's Red Gum Woodland EEC and CEEC – the BMP details the enhancement, management and monitoring of over 1,500 ha of State 1 and more than 2,000 ha of State 2 Box Gum Woodland.
- Strategic Focus Area 2 – Provide ongoing management and enhancement of existing habitats at the offset sites for threatened species – refer to entire BMP and more specifically Appendix E for management measures to be implemented at each BOA.

- Strategic Focus Area 3 – Promote a consistent and coordinated approach to weed management and pest animal control – outlined in Appendix C and Appendix E.
- Strategic Focus Area 4 – Promote a consistent and coordinated approach to fire management for biodiversity – outlined in Section 6.14 and Appendix E.
- Strategic Focus Area 5 – Enhance the connectivity of habitats through corridor and buffer area establishment and management – the BOS prepared for the project enhances existing corridors within the region as well as the re-establishment of the Regional East-West Wildlife Corridor that links the Leard State Forest to the Nandewar Range, Namoi River, Leard State Conservation Area and other large remnants.
- Strategic Focus Area 6 – Consult and workshop biodiversity issues with local stakeholders and land managers – the development of the BOS and BMP have been undertaken in consultation with DP&E, OEH, DP&I-Lands and Namoi Catchment Management Authority (now North West Branch of the LLS).

8.7 Independent BMP audit

An independent auditor approved by the Secretary of DP&E will complete an audit of revegetation works within the rehabilitation area and management and restoration activities within the BOAs by the end of the first quarter of 2018. The scope of the audit will include:

- consultation with OEH, Namoi CMA, DPI, DoEE, DRG and the CCC
- assessment of the performance of revegetation works in the rehabilitation area completed to date against the completion criteria in the RMP
- assessment of the performance of management and restoration activities in the BOAs completed to date against the completion criteria in this BMP
- identification of any measures that should be implemented to improve the performance of rehabilitation, management and restoration within the rehabilitation area and BOAs.

Following the initial independent audit in 2017, the process will be repeated every five years unless the Secretary of DP&E agrees otherwise.

9. Roles and responsibilities

Key management personnel and their relevant roles and responsibilities with regard to implementation of this BMP are detailed below in **Table 9.1**.

Table 9.1 Roles and responsibilities for implementation of the BMP

Role	Responsibility
BCOPL General Manager	Providing sufficient environment resources to ensure the effective implementation of the requirements of this plan.
BCOPL Mining Manager	Ensure the mining and biodiversity activities are undertaken in accordance with the commitments in this plan
BCOPL Environmental Superintendent	Liaising with regulatory authorities regarding BCOPL biodiversity management obligations as detailed in this plan Reviewing and updating this plan Ensuring all employees and contractors are aware of their environment management obligations in accordance with this plan Engaging specialist to undertake specific monitoring and environmental management activities in accordance with the commitments outlined in this plan Communicating the rehabilitation requirements outlined in this plan to all affected parties at BCOPL
Mining Contractor's Project Manager	Implementing biodiversity obligations in accordance this plan Developing and implementing specific procedures for the employees and subcontractors under their responsibility as required to facilitate compliance with this plan Ensuring all employees and subcontractors under their responsibility are aware of their environment management obligations Providing relevant environment data to assist BCOPL with environment reporting

10. Document Control

Revision control chart

Rev No	Revision Date	Prepared by	Reviewed by	Approved by	Signed
Original	28 Feb 2012	Alex Cockerill	W Jones	J Rennick	
1	26 Jul 2012	Alex Cockerill Chad Browning Nathan Cooper	Jan Green	Jan Green	
2	12 Oct 2012	Alex Cockerill Chad Browning Nathan Cooper	Alex Cockerill Jan Green	Jan Green	
3	28 July 2014	Lukas Clews	Jan Green	Jan Green	
4	20 Jan 2015	Deb Landenberger	Alex Cockerill	Jan Green	
5	20 April 2015	Deb Landenberger Allan Richardson	Alex Cockerill	Jan Green	
6	12 May 2015	Deb Landenberger Allan Richardson	Alex Cockerill	Jan Green	
7	3 June 2015	Deb Landenberger	Alex Cockerill	Jan Green	
8	19 Oct 2015	Deb Landenberger Kimberly Lentz	Alex Cockerill	Dan Martin	
9	12 Dec 2016	Tanya Bangel	Alex Cockerill	Dan Martin	
10	5 Oct 2017	Nathan Cooper	Alex Cockerill	Dan Martin	
11	5 Dec 2017	Tanya Bangel	Alex Cockerill	Dan Martin	
12	10 September 2018	Nathan Cooper Tanya Bangel	Alex Cockerill	Dan Martin	

11. References

11.1 Internal references

The BMP refers to the other relevant management plans required by the Project Approval and forms a part of the BCOPL Environment Management System. The below plans provide further detailed information on environmental management at Boggabri Coal Mine:

- BCOPL Rehabilitation Management Plan
- BCOPL Cultural Heritage Management Plan
- BCOPL Mining Operations Plan
- BCOPL Environmental Incident Response Management Plan.

11.2 External reference

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Appendix A

Monitoring, inspection and reporting program

Table A-1 Biodiversity Monitoring, Inspection and Reporting Program

Activity	Area	Resources	Responsibility	Frequency	Reported to
Routine monitoring					
People					
1. Ensuring all employees and subcontractors under their responsibility are aware of their environment management obligations	N/A	Boggabri Coal database	▪ Contract Owner/Supvisors ▪ Contractors	Prior to commencement of activitiy	Environment Superintendent
2. All Project personnel are appropriately qualified to complete relevant tasks	N/A	Boggabri Coal database	▪ Contract Owner/Supvisors ▪ Contractors	Prior to commencement of activitiy	Environment Superintendent
7. All operations are contained within the designated works area	Project Boundary and adjoining land	Operational plans with defined work limits	▪ Contract Owner/Supvisors ▪ Contractors	Prior to commencement of activitiy	Environment Superintendent
8. Environmental complaints have been recorded and appropriately managed	Project Boundary, BOAs and adjoining land		▪ Contract Owner/Supvisors Contractors	As required	Environment Superintendent
Biodiversity					
10. Operations are complying with the Weed and Pest Management Strategy (Appendix C)	Project Boundary and BOAs	Weed and Pest Management Strategy (Appendix C)	▪ Contract Owner/Supvisors ▪ Contractors	As required	Environment Superintendent
11. Weed and pest infestations are identified and controlled in accordance with the Weed and Pest Management Strategy (Appendix C)	Project Boundary and BOAs	Weed and Pest Management Strategy (Appendix C)	▪ Environment Superintendent ▪ Contract Owner/Supvisors ▪ Contractors	As required	Environment Superintendent

Activity	Area	Resources	Responsibility	Frequency	Reported to
12. Vegetation clearing is undertaken in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Vegetation clearing areas	Clearing and Fauna Management Procedure (Appendix B)	▪ Environment Superintendent ▪ Project Ecologist ▪ Contract Owner/Supvisors ▪ Clearing Contractors	As required	Environment Superintendent
13. Any injured animals are recorded and are dealt with in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Project Boundary	Clearing and Fauna Management Procedure (Appendix B)	▪ Environment Superintendent ▪ Project Ecologist ▪ Clearing Contractors	As required	Environment Superintendent
Biodiversity monitoring program					
14. Biodiversity monitoring completed as described in Section 8	Project Boundary, Biodiversity Corridor and BOAs		▪ Environment Superintendent ▪ Project Ecologist	Annually	Environment Superintendent
Inspections					
15. Clearing extent and site feature survey and pre-clearing survey (Appendix B)	Vegetation clearing areas	Clearing and fauna management procedure (Appendix B)	▪ Environment Superintendent ▪ Project Ecologist ▪ Project Surveyor ▪ Contract Owner/Supvisors	As required	Environmental Superintendent
18. BOA inspections (Section 8)	BOAs		Environment Superintendent	Annually	General Manager
19. Independent BMP audit (refer Section 8)	Project Boundary and BOAs		Independent Auditor commissioned by the Environment Superintendent and approved by the Secretary	By the end of 2017	Regulatory authorities
Reporting					
22. Environmental incident reports (refer Section 8)	Locality	Incident report form	All Project personnel	As required	▪ Environment Superintendent ▪ General Manager

Activity	Area	Resources	Responsibility	Frequency	Reported to
24. Biodiversity Monitoring Report (refer Section 8.3.5)	Project Boundary, Biodiversity Corridor and BOAs		▪ Environment Superintendent ▪ Project Ecologist	Annually	▪ Environment Superintendent
26. Annual Environmental Monitoring Report (refer Section 8.3.7)	Project Boundary	▪ Biodiversity monitoring report ▪ Tree Clearing Reports	Environment Superintendent	Within 28 days of the end of the reporting period	Regulatory authorities

Appendix B

Clearing and fauna management procedure

B1 Introduction

This procedure provides a framework for managing the impacts of native vegetation clearing on biodiversity within the project boundary. The methodology has been developed in consultation with key stakeholders, including DP&I and OEH, following an extensive review of literature, including:

- publically available procedures, plans and strategies developed for tree clearing operations within mines and other large-scale development projects across NSW and Australia
- animal ethics guidelines published by regulatory authorities and committees throughout Australia
- the draft *Queensland code of practice for the welfare of wild animals affected by land-clearing and other habitat impacts and wildlife spotter/catchers* (Australian Wildlife Hospital, 2009).

Specifically, this procedure aims to:

- ensure the extent of native vegetation removal is minimised and consistent with the requirements of the project
- minimise impacts on native biodiversity, particularly threat-listed species, populations and communities
- maximise the usage of products of clearing (large woody debris, topsoil, subsoil and natural hollows) to improve biodiversity values.

The project will result in the removal of approximately 1,385 ha of native vegetation, including 624 ha of the EPBC Act and TSC Act listed Box Gum Grassy Woodland Community (refer to Section 2.1.1.1). Tree hollow resources within the project boundary have been estimated in the *Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment* (Parsons Brinckerhoff 2010a), as detailed below in Figure B1.

Figure B1 Hollow sizes and average numbers recorded/ha within the Project Boundary (Leard State Forest)

B.2 Clearing protocol

Figure B2 below provides a general overview of the procedure for native vegetation clearing within the project boundary.

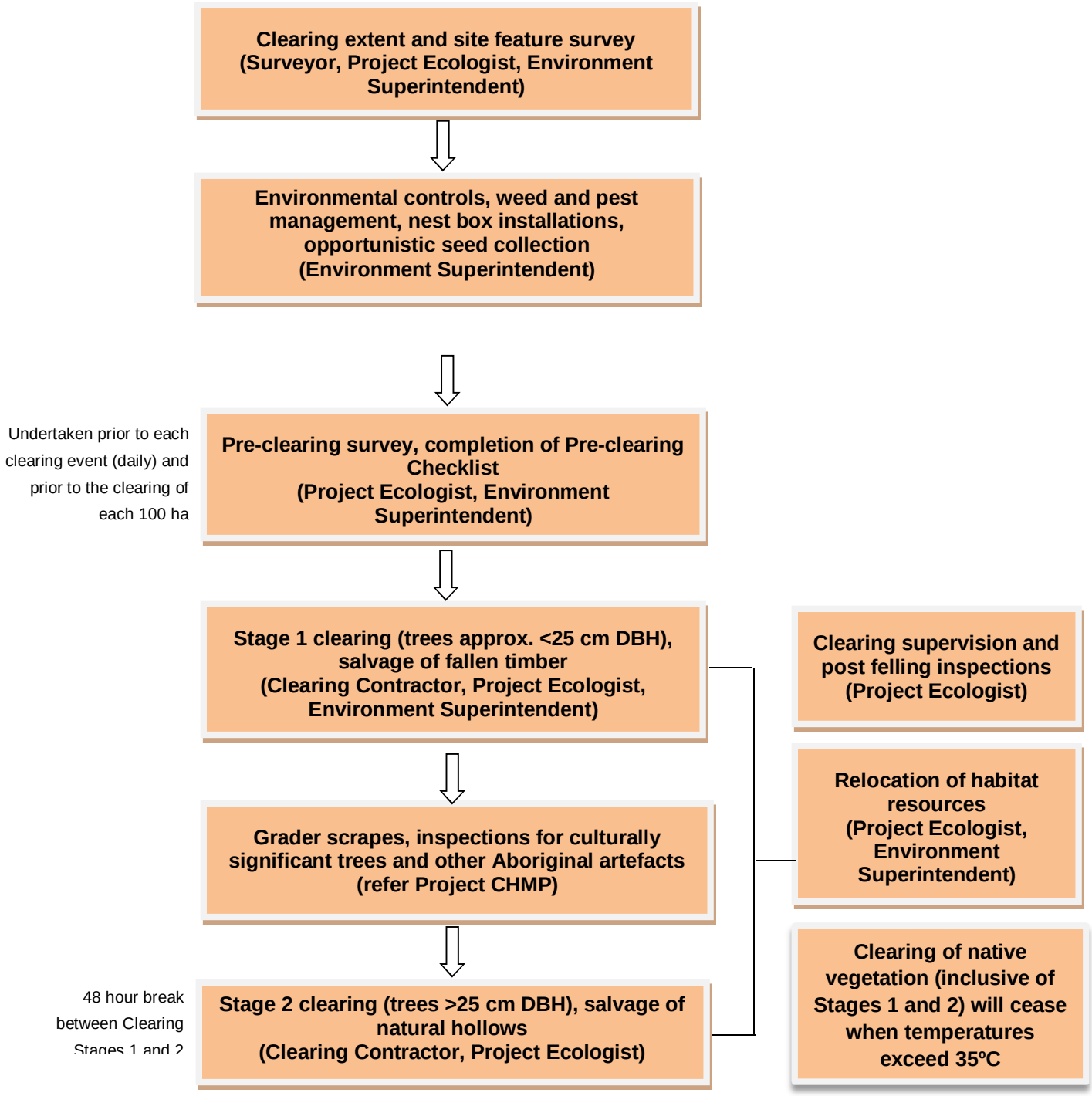

Figure B-2 Overview of the native vegetation clearing procedure

B2.1 Clearing extent and site feature survey

The initial phase of the clearing protocol involves the delineation of areas to be cleared of native vegetation. The clearance footprint will be surveyed and clearly marked to prevent the disturbance or accidental clearing of adjoining native vegetation and to ensure that only the minimum number of trees is cleared to allow for mining in the following year. During the survey the environment superintendent and/or project ecologist will be responsible for:

- Identifying and marking of all habitat with the symbol “H”. Habitat trees will include both hollow bearing trees and trees containing any fauna habitat feature (nests, roosts etc.).
- Ensuring all proposed clearing works are within the approved boundary and that the limit of clearing is marked with survey pegs and flagging tape at 25 m intervals in areas adjacent to EEC’s and in dense areas (where practical). Line of sight between pegs will be generally used in other areas.
- Identifying clearing constraints, environmentally sensitive areas (water features, steep/uneven terrain) and appropriate controls (hand-felling, sedimentation fencing).
- Completing targeted searches for threat-listed plants within the clearing footprint. If individuals of previously unrecorded threatened species are identified, OEH and/or DoE will be consulted (at Regional Co-ordinator level or equivalent) prior to any clearing within the subject site.
- Identifying the type and extent of vegetation communities within the clearing footprint.
- Identifying weed and pest infestations to be controlled before clearing, in accordance with the Weed and Pest Management Strategy (Appendix C). Identifying requirements for seed collection, in accordance with the BMP.
- Identify the location and area required for stockpiling of salvaged habitat resources.
- Undertaking quantitative assessments of habitat resources within the clearing footprint to allow a comparison between the extent of existing and salvaged habitat features. The project ecologist will complete 20 x 50 m transects/plots in each clearing block in accordance with the minimum sampling stratification identified in the BBAM survey methodology ((Department of Environment Climate Change 2009b), the following data will be recorded on the Clearing Extent and Site Feature Checklist (Table B-2):
    - hollow-bearing trees
    - abundance of hollows, categorised by size
    - bush rocks (m^2)
    - fallen timber (m) – at least 5 cm DBH and 1 m long.
- Identifying suitable relocation sites for rescued fauna. The selection of relocation sites will be undertaken separately for each clearing block. These sites will be inspected during the clearing extent and site feature survey to assess environmental attributes and ensure that the extent of habitat resources present is at least equal to the conditions recorded in the clearing footprint.

In order to limit the number of rescued fauna relocated to one area, separate relocation sites will be designated for each clearing block. Where a relocation site has not received rescued mammals and clearing with the designated block is complete, it may be used for subsequent clearing blocks. Furthermore, the number of arboreal mammals relocated to each site will not exceed the number of nest boxes installed before clearing (refer Section B2.2).

The Clearing Extent and Site Feature Checklist provided as Table B-1 will be completed by the project ecologist and environment superintendent for each clearing block.

Table B-1 Clearing Extent and Site Feature Checklist

Site Features (Project Ecologist) – to be completed for each clearing block				
Site ID	**Clearing block (ha):**	**Relocation Site:**	**Relocation Site:**	**Relocation Site:**
Location description				
Vegetation communities mapped/present and extent				
Threat-listed species				
Extent of habitat resources (description)				
Habitat/Significant trees have been identified and marked.				
Waypoint (GDA94) and photo references	E: N:	E: N:	E: N:	E: N:
Quantitative assessment of habitat resources within the clearing block (50 x 20 m transects)				
Transect ID	**Transect:**		**Transect:**	
Coordinates (GDA94)	E: N:		E: N:	
Photo references				
Number of Significant trees (DBH >100cm).				
Number of hollow-bearing trees				
Hollows <5 cm				
Hollows 5-15 cm				
Hollows 16-25 cm				
Hollows 26-30 cm				
Hollows >30 cm				
Bush rocks (m^2)				
Fallen timber (m) - at least 5 cm DBH and 1 m long				

B2.2 Pre-clearing survey

Prior to clearing each block, the project ecologist and environment superintendent will complete the pre-clearing checklist provided as Table B-3.

During Stage 1 and 2 clearing events, the project ecologist will undertake a pre-clearing survey each morning, prior to clearing. The aim of this survey will be to inspect terrestrial habitat resources (fallen timber) and relocate any resident fauna encountered (refer Section B2.1). Additionally, pre-clearing surveys will be undertaken to record the habitat resources salvaged during previous Stage 1 and 2 clearing events (refer Sections B2.5 and B2.6). The relocation of habitat resources is discussed in Section B2.7.

Table B-2 Pre-clearing Checklist (completed for each clearing block)

Date form completed:	**Environment Superintendent:**
Clearing block ID:	**Project Ecologist:**

Proposed Action/Control Measure	Action By	Checked (initial)	Comments
Site Personnel have been adequately trained/inducted to the Project and activity location.	Environment Superintendent or Project Ecologist		
All habitat trees have been identified and marked with a 'H"	Project Ecologist		
The clearing extent and site feature survey is complete and all boundaries have been marked appropriately. (Limit of clearing is marked with survey pegs and flagging tape at 25 m intervals in areas adjacent to EEC's and in dense areas (where practical). Line of sight between pegs has been used in other areas).	Environment Superintendent or Surveyor		
Environmentally sensitive areas have been identified and appropriate control measures are in place.	Environment Superintendent or Project Ecologist		
Significant areas of weeds and pest infestations have been identified and controlled before clearing, in accordance with the Weed and Pest Management Strategy.	Environment Superintendent		
Targeted searches for threat-listed plants have been undertaken. If individuals previously unrecorded are identified, OEH and/or SEWPAC must be contacted prior to any clearing within the subject site.	Environment Superintendent or Project Ecologist		
Appropriate fauna relocation sites have been designated.	Environment Superintendent or Project Ecologist		
Local veterinary surgeries and wildlife organisations have been contacted to confirm the availability of care resources.	Environment Superintendent or Project Ecologist		
The clearing contractor has been directed to salvage natural hollows and any bush rocks, as per the procedures described in Sections B2.5 and B2.6 of the Clearing and Fauna Management Procedure.	Environment Superintendent or Project Ecologist		
Stockpile locations for salvaged resources has been identified and marked out to clearing contractors	Environment Superintendent or Project Ecologist		

Record of salvaging habitat resources post-clearing
Number of hollow-bearing trees
Number of hollow-bearing limbs: <5 cm 5-15 cm 16-25 cm 26-30 cm >30 cm
Bush rocks (m^2)
natural hollows (m) - at least 5 cm DBH and 1 m long

B2.3 Stage 1 clearing and grubbing

In accordance with Forestry NSW requirements, only shrubs and trees < 25 cm DBH and not identified as habitat trees in the pre clearing survey will be removed during Stage 1 clearing works. Based on past tree clearing operations within Leard SF 75% of trees with a DBH >25 cm are habitat trees. All habitat trees will be clearly marked prior to commencing the Stage 1 clearing.

Prior to commencing Stage 1 clearing machinery operators will be trained by the project ecologist in the identification of trees >25 cm DBH. During the Stage 1 clearing operation the project ecologist will also conduct an audit to ensure machinery operators are complying with this requirement.

Traditional methods for clearing will be employed using excavators, dozers, loaders and trucks where possible.

During Stage 1 clearing, the machinery operators will be instructed by the project ecologist to maximise the salvage of habitat resources. It is noted that the proposed clearing footprint contains very few bush rocks, however, where encountered these habitat resources will be relocated.

Operators will be instructed by the project ecologist to salvage as many habitat resources possible. The overall goal of salvage operations during Stage 1 clearing will be to maximise the recovery of habitat resources present in accordance with the projects conditions of approval. This quota will be monitored by the project ecologist, with reference to transect data collected from the clearing footprint during the clearing extent and site feature survey.

The project ecologist will be present during all clearing operations to inspect the site immediately before clearing and capture/relocate any identified animals. Following clearing, the project ecologist will complete post felling inspections to relocate/treat any injured or remaining animals.

Products of Stage 1 clearing not salvaged for habitat creation will be stockpiled and chipped for on-site landscaping.

All clearing of native vegetation, inclusive of Stage 1 and Stage 2 (i.e. salvage of fauna habitat, clearing of under-storey and removal of both habitat and non-habitat trees), will cease when temperatures exceed 35ºC.

B2.4 Stage 2 clearing

Stage 2 clearing will commence no shorter than 48 hours following Stage 1 works.

Where hollow-bearing trees are to be removed, the operation will be performed by careful felling, and not with the use of an excavator mounted closed chipper. Hollow-bearing trees will be gently shaken or agitated before felling to encourage any remaining animals to either leave the tree or at least show themselves before felling. Hollow-bearing trees will be felled sequentially and succeeding trees not felled until direction is given by the project ecologist. Felling will involve gently pushing the tree and lowering to avoid sudden falling as this is likely to injure wildlife. Subsequent to felling, hollow-bearing trees will be systematically checked for any remaining fauna.

Felled hollow-bearing trees will be left in place for 24 hours to allow any undetected fauna further opportunity to escape.

Following the clearance of hollow-bearing trees, the project ecologist will identify and mark natural hollows for potential salvage as hollow ground timber or arboreal hollows. The overall goal of salvage operations during Stage 2 clearing will be to maximise the recovery of habitat resources in accordance with the projects conditions of approval. This quota will be monitored by the project ecologist, with reference to transect data collected from the clearing footprint during the clearing extent and site feature survey.

If any habitat tree is found or suspected (based on fresh tree markings or scats) to contain any species, the tree will be left in place for a minimum of 48 hours and be re-inspected before felling.

Captured animals will be relocated to designated relocation sites, as per the methodology described in Section B2.1. After the completion of fauna relocation, a brief record detailing the findings of the survey and relocation will be prepared, including details of:

- any live animals that are sighted, captured, released, injured, shocked or killed as a result of clearing operations and fauna rescue
- records of the fauna relocation sites (refer Table B-2)
- tree species being used for breeding or roosting by fauna, including tree locations, sizes, heights and depths of hollows
- the success/survival rate of animals that are reared or released by a wildlife organisation.

This information will be included in the tree clearing report, completed and submitted to the environment superintendent following each clearing event (refer Section 9.3.2).

The management of topsoil and subsoil during clearing operations is directed by the Soil Management Protocol (Appendix H). All clearing of native vegetation, inclusive of Stage 1 and Stage 2 (i.e. salvage of fauna habitat, clearing of under-storey and removal of both habitat and non-habitat trees), will cease when temperatures exceed 35°C.

B2.5 Salvage of habitat resources

Habitat resources will be relocated to BOAs, fauna relocation sites or areas of mine rehabilitation.

The relocation of habitat resources to BOAs will be undertaken in accordance with the specific BOA Management Plans (Appendix E of the BMP). The provision of habitat resources within fauna relocation sites will be triggered where such sites provide fewer habitat resources than the clearing footprint.

B2.6 Fauna handling and care

Prior to clearing, veterinary surgeries and wildlife organisations will be contacted to confirm the availability of care resources. All correspondence with wildlife rescue organisations, veterinary surgeons and any other group regarding injured wildlife will be recorded by the environment superintendent. Injured animals will be cared for according to specific animal care and ethics guidelines (http://www.animalethics.org.au/reader/arrp-policies-and-guidelines) and be given appropriate veterinary care, and if available, the services of local animal welfare groups will be engaged (Table B-4).

Table B-3 Local veterinary clinics and animal welfare organisations

Organisation	Contact details
Gunnedah Veterinary Hospital	14-16 Barber Street, Gunnedah 02 67421834
Gunnedah Animal Health Centre	33 Chandos Street, Gunnedah (02) 6742 5585
Wildlife Information and Rescue Service (WIRES) Central Northern Branch	1300 131 554
Wildlife Aid Rescue – Hunter Valley	0447 66 7737
Waterways Wildlife Park - wildlife carer	Oxley Highway, 7km West of Gunnedah 02 6742 1826

Any uninjured animals rescued will be relocated to a suitable predetermined fauna relocation site. Records are to be kept of each animal's details including species, sex, weight, size and condition.

The following criteria will be met for all animals kept for night release or transported to an approved carer:

- the animal is protected from extremes of temperature
- the animal is protected from accidental trauma by other animals, equipment, machinery and the like
- the animal is protected from adverse sensory stimuli such as loud noises
- the bag or container provides sufficient airflow to allow normal air exchange and radiation/dispersal of heat
- the container, receptacle or bag is protected from direct sunlight, rain, wind or other environmental conditions likely to cause suffering or harm to the animal
- the animal is checked regularly during its period of confinement
- the container, bag or receptacle is clean, hygienic and safe for the animal
- all mammals and birds held in short term containment for more than four hours are given access to water

- the guidelines contained in Table B-4 for the short-term (4-24 hours) containment of adult animals are adhered to.

Table B-4 Guidelines for short-term containment (adult animals)

Species	Water (hrs)	Food (hrs)	Max. time in bag	Max. time in short-term enclosure (transport box)
Macropod	4	12	N/A	N/A
Koala	4	4	2	4
Echidna	4	8	2	24
Possum/ glider	4	8	2	24
Rodent	4	8	2	24
Microbat	4	4	12*	12
Dasyurid	4	4	2	24
Flying fox	4	8	2**	12
Snake	24	7 days	24	24
Lizard	24	48	24	24
Turtle	24	48	24	24
Frog	12#	24	8#	24

* Only if fed and watered every 4 hours
** Calico bags containing flying foxes must be hung rather than laid down.
# Containers for frogs must prevent drying. Plastic boxes with ventilation are preferred.

In some instances severely injured animals may need to be euthanased on site to prevent prolonged suffering. Euthanasia of native species will only be conducted under the requirements of the Animal Care and Protection Act 2001 will be met in respect of the method of euthanasia and methods will confirm with the appropriate animal ethics licence and the recommendations contained in the 2001 Australian and New Zealand Council for the Care of Animals in Research and Teaching (ANZCCART) publication 'Euthanasia of Animals Used for Scientific Purposes' (Australian and New Zealand Council for the Care of Animals in Research and Teaching (ANZCCART) 2001)

B2.7 Qualifications of spotter/catchers (project ecologist)

The management of clearing operations and all fauna handling and care will be undertaken by qualified ecologists with practical experience in undertaking spotter/catcher activities. Spotter/catchers will operate under relevant permits and licences and:

- Thold current animal ethics approval and appropriate animal handling permits
- have detailed knowledge of, and proven experience in:
  - survey techniques of all vertebrate fauna
  - identification of vertebrate fauna, and threat-listed invertebrate fauna

- the humane capture, trapping and handling of vertebrate fauna
- identification of habitat and or habitat resources of significant fauna
- ecological processes and the relevance for fauna
- data recording and written reporting
- humane techniques for emergency euthanasia of vertebrate animals
- all State and Commonwealth legislation relevant to the conduct and responsibilities of wildlife spotter/catchers

- have appropriate equipment for the rescue and care of wildlife
- be vaccinated against the following infectious conditions:
  - Australian Bat Lyssavirus (ABL) – rabies vaccination
  - Coxiella burnetti (Q Fever) – Q Fever vaccination
  - Tetanus.

Appendix C

Weed and pest management strategy

C1 Introduction

Weed and pest species are effective competitors for food and habitat resources and have the potential to exclude native species and modify the composition and structure of vegetation communities. Disturbance associated with vegetation clearing, vehicle traffic and general day to day operations of the Project increase the potential for the introduction and establishment of weed and pest species.

This Weed and Pest Management Strategy provides a framework for managing these species within the Project Boundary and BOAs. Specifically, this strategy aims to ensure that:

- weeds and pests are managed in accordance with relevant regulatory requirements and guidelines
- the introduction and spread of weed and pest species are monitored and controlled as required
- control measures are undertaken by trained and experienced personnel, in consultation with relevant key stakeholders, including Narrabri Shire Council and adjoining land managers.

C2 Weed management

For the purposes of this strategy, a weed is defined as any plant species listed under the following:

- noxious weed declarations under the *Noxious Weeds Act 1993* for the Narrabri Shire Council control area
- National Weeds Strategy – Weeds of National Significance (WoNS).
- National Weeds Strategy – National Environmental Alert List.

Seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010) recorded 61 species of introduced flora within the Project Boundary. Of the introduced species recorded, nine are listed under the Noxious Weeds Act 1993 for the Narrabri Shire Local Government Area (LGA) and one (*Rubus ulmifolius*) is classified as a WoNS (Weeds Australia 2011) (Table C-1). No species listed on the National Environmental Alert List were recorded during the 2008-2009 surveys.

Table C-1 Weeds identified within the Project Boundary (December 2008 and September 2009)

Family	Scientific name	Common name	*Noxious Weeds Act 1993*	WoNS	National Environmental Alert List
Apiaceae	*Conium maculatum*	Hemlock	Class 4[1]	-	-
Asteraceae	*Xanthium spinosum*	Bathurst Burr	Class 4	-	-
Asteraceae	*Xanthium strumarium*	-	Class 4	-	-
Boraginaceae	*Heliotropium amplexicaule*	Blue Heliotrope	Class 4	-	-
Cactaceae	*Opuntia aurantiaca*	Tiger Pear	Class 4	-	-
Cactaceae	*Opuntia stricta*	Prickly Pear	Class 4	-	-
Cactaceae	*Opuntia tomentosa*	Velvet Tree Pear	Class 4	-	-
Chenopodiaceae	*Sclerolaena birchii*	Galvanized Burr	Class 4	-	-
Rosaceae	*Rubus ulmifolius*	Blackberry	Class 4	Yes	-

Note: Control class for noxious weeds under the Act.
Class 4 - Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area. Example control requirements: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

Site inspections completed within each identified priority areas for weed control, particularly within the Corridor enhancement zones and Habitat Restoration Zones. Specific weed control measures for each BOA are included in the specific BOA Management Plans, attached as Appendix E.

C2.1 Statutory requirements and guidelines

Legislation and information sources relevant to weed management within the Project Boundary and BOAs are listed and summarised in Table C-2.

Table C-2 Legislative controls and information sources for weed management

Legislation/information source	Notes	Reference
NSW Noxious Weeds Act 1993	Plants may be declared as noxious weeds under the *Noxious Weeds Act 1993* and are typically species that have potential to cause harm to the community and individuals and have the potential to spread within an area and to other areas. In NSW the administration of noxious weed control is the responsibility of the Minister for Primary Industries under the Act. The Act is implemented and enforced by the Local Control Authority for the area (Narrabri Shire Council) The Act imposes obligations on occupiers of land to control noxious weeds declared for their area.	http://www.austlii.edu.au/au/legis/nsw/consol_act/nwa1993182/
Pesticides Act 1999	This Act regulates and provides for the control and use of pesticides. Records should be kept of any pesticides used during the Project.	http://www.austlii.edu.au/au/legis/nsw/consol_act/pa1999120/
Pesticide Regulation 1999	This Regulation specifies training requirements for personnel handling and/or applying pesticides.	http://www.legislation.nsw.gov.au/sessionalview/sessional/sr/2009-417.pdf
Pesticide Permits and Registration	The use of herbicides during weed control will require registration permits which can be obtained online from the Australian Pesticides and Veterinarian Medicines Authority (APVMA) website. Weed control must only be undertaken with herbicides registered for treatment of each specific weed, and in accordance with manufacturer's directions.	http://www.apvma.gov.au/index.asp.
Narrabri Shire Council Weed Management Plans	The Narrabri Shire Council has developed management plans for 18 noxious weed species (including Blackberry, Blue Heliotrope, Hemlock and Prickly Pear).	http://narrabri.cfm.predelegation.com/index.cfm?page_id=1195
Northern Inland Weeds Advisory Committee (NIWAC) website	This website provides a resource for weed strategies, management plans and contacts within the NIWAC region.	http://www.niwac.org/
North West Weeds website	This website contains information regarding the identification and control of weeds in central NSW. Details of weed control contractors are also provided.	http://www.northwestweeds.nsw.gov.au/

Legislation/information source	Notes	Reference
The DTIRIS Primary Industries weeds website	This website provides an overview of weed management in NSW. The status of weeds and control information is updated regularly.	http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
DTIRIS Primary Industries Primefacts	The Primary Industries division of DTIRIS produces a range of fact sheets for land management, including Primefacts. Fact sheets are available for a range of weed species and control measures.	http://www.dpi.nsw.gov.au/aboutus/resources/factsheets

C2.2 Management actions

Noxious weeds within the Project Boundary and BOAs will aim to be controlled in accordance with the requirements of the *Noxious Weeds Act 1993*. The implementation of the Monitoring, Inspection and Reporting Program (refer Section 8) and specific BOA measures (Appendix E) will reduce the potential for weed introduction and spread and allow ongoing monitoring and control.

The introduction and spread of weed species will be minimised within the Project Boundary by complying with the Clearing and Fauna Management Procedure (Appendix B) during clearing activities, restricting access to areas of native vegetation and communicating the responsibilities of all Project personnel at site inductions and during regular toolbox meetings.

C2.3 Control methods for noxious weeds

Detailed methods and chemical application rates for the control of noxious weeds are provided in specific weed management plans prepared by Narrabri Shire Council or contained in the *Noxious and Environmental Weed Control Handbook* (Ensbey & Johnson 2009).

C2.4 Herbicide use protocol

Safety directions, first aid, storage and disposal, protection of non-targeted plants, protection of wildlife, fish, crustacea and the environment shall be as described by the manufacturer and detailed on the product label and Safety Data Sheet (SDS). Personnel or contractors using herbicides must carry the product label and SDS for all herbicides and related chemicals carried (including herbicide dyes and wetting agents). Personnel using herbicides will be adequately trained.

Chemical treatment is to be carried out with regard to the following matters:

- the use of herbicide is generally the most efficient means of controlling weeds on site, however other appropriate techniques of weed control will not be discounted (i.e. hand pulling seedlings in proximity to native plants)
- the use of herbicides will be undertaken in consideration of impacts to adjoining properties and where required in consultation with adjoining landholders
- non-residual herbicides will be used in preference to residual herbicides unless these are required and appropriate control measures are assessed
- herbicides will not be sprayed over any open water unless appropriate control measures have been assessed

- chemical use will be undertaken in accordance with product label and SDS requirements
- different herbicides will not to be mixed or used contrary to the uses prescribed on the product label
- chemicals will be stored, transported or used in accordance with relevant label information and Australian Standards so as to ensure compliance with Environment Protection Legislation
- disposal of empty chemical containers will comply with label, MSDS, and local government requirements
- herbicide will be applied carefully to avoid damage to non-target species, if native species are growing close to target weed species they will be shielded from spray damage
- foliar spraying will not be undertaken during or preceding unsuitable weather conditions such as rain or wind that may cause spray drift
- following the use of pesticides, the Pesticide Application Record Sheet will be completed and provided to the Environment Superintendent (Table C-3).

Table C-3 Pesticide application record sheet

Pesticide use information	
Date and time:	
Personnel applying pesticide:	
Treatment area coordinates	Easting: Northing: Datum:
Treatment area description:	
Target weed species:	
Equipment used:	
Chemical name, concentration and rate:	
Area covered by application:	
Wind speed and direction:	
Other weather details:	

Pesticide use information
Other notes:

C3 Pest management

Seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010) recorded seven pest species including Common Starling, Fox, Brown Hare, Rabbit, Black Rat, Common House Mouse and Pig.

Site inspections completed within each BOA indicated little evidence of pest infestations throughout the properties. Pest species identified within the BOAs include Common Starling, Fox, Brown Hare, Rabbit, Pig and Goats (particularly within the Namoi BOA).

C3.1 Statutory requirements and guidelines

Legislation and information sources relevant to pest management within the Project Boundary and BOAs are listed and summarised in Table C-4.

Table C-4 Legislative controls and information sources for pest management

Legislation/information source	Note	Reference
Rural Lands Protection Act (1998)	Under the Act landholders are obligated to control feral pigs, wild dogs and wild rabbits through pest control orders. LHPAs are charged with enforcing the orders. The Project Boundary and BOAs are located within the Central North LHPA region.	http://www.austlii.edu.au/au/legis/nsw/consol_act/rlpa1998256/
NSW Threat Abatement Plan for Predation by the Red Fox	This plan establishes priorities for fox control for the conservation of biodiversity across NSW. The plan is coordinated by OEH. In particular, the plan identifies which threatened species are most likely to be impacted by fox predation and the sites at which these impacts are predicted to be most critical.	http://www.environment.nsw.gov.au/threatenedspecies/RedFox-FinalThreatAbatementPlan.htm
Pesticides Act 1999	This Act regulates and provides for the control and use of pesticides. Pesticide Control Orders are required for the use of certain pesticides (e.g. 1080 fox bait).	http://www.austlii.edu.au/au/legis/nsw/consol_act/pa1999120/
Pesticide Regulation 1999	Specifies the training requirements for personnel handling and/or applying pesticides.	http://www.legislation.nsw.gov.au/sessionalview/sessional/sr/2009-417.pdf
Code of Practices and Standard Operating Procedures	Code of Practices and Standard Operating Procedures have been developed for a range of pest animal control methods. These documents are available on the DoE and PestSmart website.	http://www.environment.gov.au/biodiversity/invasive/publications/humane-control.html http://www.pestsmart.org.au/

Legislation/information source	Note	Reference
Central North Livestock Health and Pest Authority	The Central North LHPA website contains media releases relating to pest management and contact details of local staff.	http://www.lhpa.org.au/districts/centralnorth
DTIRIS Primary Industries pest animals website	This website provides an overview of pest management in NSW. Information regarding pest species and their management is updated regularly.	http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
OEH pest animals website	Similarly to the DTIRIS website, this website provides an overview of pest management in NSW.	http://www.environment.nsw.gov.au/pestsweeds/pestanimals.htm
DTIRIS Primary Industries Primefacts	Primefacts are available for a range of pest species and control measures.	http://www.dpi.nsw.gov.au/aboutus/resources/factsheets

C3.2 Management actions

Pest animals within the Project Boundary and BOAs will be identified and controlled as part of the Monitoring, Inspection and Reporting Program (refer Section 8) and specific BOA measures (Appendix E). The potential for the introduction and spread of pest animals will be minimised by implementing the following measures when pest infestations are identified.

C3.3 Control methods for declared pests

Pest control measures will be implemented to control any infestations in consultation with key stakeholders including the Central North LHPA, Narrabri Shire Council and adjoining land managers. Control strategies may include the destruction of burrows, shooting, trapping and baiting.

Pest control actions will be undertaken with reference to Code of Practices and Standard Operating Procedures found at the above web sites (refer to Table C-5).

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Appendix D

Threatened species recorded or predicted to occur within 20 km of the project boundary

Table D-1 Threatened flora species recorded or predicted to occur within 20 km of the Project Boundary

Scientific name	Common name	EPBC Act[1]	TSC Act[2]	Habitat[3]	Flowering time	Notes	Likelihood of occurrence	Recorded or predicted to occur in BOA[6]						
								Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine
Digitaria porrecta[4]	Finger Panic Grass	E	E1	In NSW it occurs in north western slopes and north western plains subdivisions (Royal Botanic Gardens 2004) where it grows in native grassland, woodlands or open forest with a grassy understorey, on richer soils. It is often found along roadsides and travelling stock routes where there is light grazing and occasional fire (Department of Environment and Conservation 2005).	Summer		**High**. There is marginal preferred habitat for this species available within the Project Boundary.	**P**	**R**	**P**	**P**	**P**	**P**	**P**
Diuris tricolor	Donkey Orchid	V	V	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2005), or in grassy Callitris woodland It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Soils include gritty orange-brown loam on granite, shallow red loamy sand on stony porphyry, skeletal lateritic soil and alluvial grey silty loam. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats(Department of Environment and Conservation 2005). Within the Upper Hunter it is known to occur in *Eucalyptus albens/Eucalyptus crebra/Eucalyptus blakelyi/Corymbia maculata* woodland complexes and grasslands (Parsons Brinckerhoff 2004).	September - November		**Moderate**. There is preferred habitat for this species available within the Project Boundary. However this species was not recorded despite targeted surveys during the flowering period.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Pomaderris queenslandica	Scant Pomaderris		E1	Widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW north coast (Department of Environment and Conservation 2005). It grows in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (Department of Environment and Conservation 2005).	Spring-summer	Species has been recorded in the Project Boundary[5].	**High.** This species was recorded within the Project Boundary in the Narrow-leaved Ironbark – White Cypress Pine shrubby open forest. This species was only recorded in the Leard State Forest in the offset areas. It has not been recorded within the proposed mining areas.	**P**	**P**	**N**	**P**	**N**	**R**	**P**
Pultenaea setulosa		V		Occurs in central coast, central and northern tablelands and western slopes bioregions west to Gilgandra district. It grows in dry sclerophyll forest (Royal Botanic Gardens 2005).	Spring	Species has been recorded in the Project Boundary[5].	**High:** This species has been recorded within the Project Boundary.	**N**	**N**	**N**	**N**	**N**	**P**	**P**
Tylophora linearis		E	V	*Tylophora linearis* has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW, and "Myall Park" near Glenmorgan in Queensland. This species is conserved within Goobang National Park, Eura State Forest, Goonoo SF, Pilliga West SF and Coolbaggie Nature Reserve. *Tylophora linearis* grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E. sideroxylon, E. albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata*, *Myoporum* spp., and *Casuarina* spp. (Department of Environment Water Heritage and the Arts 2008; NSW Scientific Committee 2008).	Spring	The Leard State Forest is now known to provide suitable habitat for a population of *Tylophora linearis* since this species was recorded during targeted surveys in 2014.	**High.** The Leard State Forest is now known to provide suitable habitat for a population of *Tylophora linearis.* As similar White Box habotats exist in the BOAs, this species is considered likely to occur.	**P**	**P**	**P**	**R**	**P**	**R**	**P**

Notes:
1: Listed as Endangered (E) of Vulnerable (V) under the EPBC Act
2. Listed as Endangered (E1) or Vulnerable (V) under the TSC Act
3. Based on database searches and field surveys
4. *Digitaria porrecta* is currently undergoing a status review to downgrade listing from Endangered to Vulnerable under the EPBC Act
5. Recorded during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010).
6. COMMITTEE – (R) – Recorded in the BOAs, (P) – Moderate of greater likelihood of occurrence, (N) – Not recorded or predicted to occur within the BOAs

Table D-2 Threatened fauna species recorded or predicted to occur within 20 km of the Project Boundary

Scientific name	Common name	EPBC Act[1]	TSC/FM Act[2]	Preferred habitat[4]	Likelihood of occurrence	Recorded or predicted to occur in BOA[5]						
						Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine
Amphibians												
Crinia sloanei	Sloane's Toadlet		V	Sloane's Froglet is a small (25mm), cryptic ground-dwelling frog which is found in woodland, grassland and open or disturbed areas, usually associated with inundated areas (Robinson 1998).	**Moderate**. Suitable habitats are available for this species	**N**	**P**	**N**	**P**	**N**	**P**	**N**
Native Birds												
Ardea alba	Great Egret	M		Great Egrets occur throughout most of the world. They are common throughout, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. In Australia, the breeding season of the Great Egret is normally October to December in the south and March to May in the north. This species breeds in colonies, and often in association with cormorants, ibises and other egrets. (Australian Museum 2003).	**Moderate**. Suitable habitats are available for this species.	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Ardea ibis	Cattle Egret	M		Subspecies A. i. coromanda is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan 2005).	**Moderate**. Suitable habitats are available for this species.	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Artamus superciliosus	White-browed Woodswallow		V[6]	The White-browed Woodswallow occurs in eastern, northern and central Australia. In NSW it typically breeds in open forests and woodlands from the inland slopes to the far western plains but during dry years its distribution extends east to open habitats of the tablelands and coast (NSW Scientific Committee 2009).	**High**. This species was recorded during field surveys within the project boundary.	**R**	**R**	**R**	**R**	**R**	**P**	**P**
Certhionyx variegatus	Pied Honeyeater		V	Inhabits wattle shrub (primarily Mulga, *Acacia aneura*), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering: feeds on nectar, predominantly from various species of emu-bushes (Eremophila spp.): also from mistletoes and various other shrubs (e.g. Brachysema spp. and Grevillea spp.): also eats saltbush fruit, berries, seed, flowers and insects (Higgins and Marchant 2001).	**Moderate**. Suitable habitats are available for this species.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Circus assimilis	Spotted Harrier		V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast and ranges. Individuals disperse widely in NSW and occur in grassy open woodland including acacia and mallee remnants, inland riparian woodland and grassland. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (NSW Scientifc Committee 2010).	**High**. This species was recorded during field surveys	**P**	**P**	**P**	**R**	**P**	**P**	**P**
Climacteris picumnus	Brown Treecreeper		V	Occurs in eucalypt woodland and adjoining vegetation. Feeds on ants, beetles and larvae on trees and from fallen timber and leaf litter. Usually nests in hollows (Garnett & Crowley 2000; NSW Scientifc Committee 2010).	**High**. This species was recorded during field surveys	**R**	**R**	**R**	**R**	**R**	**R**	**R**

Scientific name	Common name	EPBC Act[1]	TSC/FM Act[2]	Preferred habitat[4]	Likelihood of occurrence	Recorded or predicted to occur in BOA[5]						
						Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine
Daphoenositta chrysoptera	Varied Sittella		V	The Varied Sittella is sedentary and inhabits most of mainland Australia with a nearly continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches and twigs in the tree canopy (NSW Scientific Committee 2010).	**High**. This species was recorded during field surveys	**R**	**N**	**P**	**R**	**R**	**R**	**P**
Ephippiorhynchus asiaticus	Black-necked Stork		E1	Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garnett & Crowley 2000).	**Moderate**. This species was recorded in the localityduring field surveys, but not within offset lands.	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Glossopsitta pusilla	Little Lorikeet		V	Found in forests, woodland, treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria (Higgins 1999).	**High**. This species was recorded during field surveys	**R**	**P**	**R**	**R**	**P**	**R**	**R**
Grantiella picta	Painted Honeyeater		V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).	**Moderate**. Suitable habitats are available for this species.	**P**	**P**	**P**	**R**	**R**	**P**	**P**
Hieraaetus morphnoides	Little Eagle		V	The Little Eagle is distributed throughout the Australian mainland except in the most densely forested parts of the Dividing Range. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch. It feeds on birds, reptiles and mammals (NSW Scientific Commitee 2010).	**High**. This species was recorded during field surveys	**R**	**P**	**R**	**P**	**P**	**P**	**P**
Hirundapus caudacutus	White-throated Needletail	M		Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 2007).	**High**. This species was recorded during field surveys	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Lathamus discolor	Swift Parrot	E	E1	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants. Sites used vary from year to year. (Garnett & Crowley 2000),(Swift Parrot Recovery Team 2001).	**High**. Suitable habitats are available for this species.	**P**	**P**	**P**	**P**	**R**	**P**	**P**
Lophoictinia isura	Square-tailed Kite		V	This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes (Garnett & Crowley 2000).	**High**. This species has previously been recorded in Leard State Forest.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Melanodryas cucullata	Hooded Robin		V	Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000).	**High**. This species was recorded during field surveys.	**R**	**R**	**P**	**R**	**P**	**P**	**P**
Melithreptus gularis gularis	Black-chinned Honeyeater		V	Found in dry eucalypt woodland particularly those containing ironbark and box. Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000).	**High**. This species was recorded during field surveys.	**P**	**P**	**P**	**P**	**P**	**R**	**P**

Scientific name	Common name	EPBC Act[1]	TSC/FM Act[2]	Preferred habitat[4]	Likelihood of occurrence	Recorded or predicted to occur in BOA[5]						
						Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine
Merops ornatus	Rainbow Bee-eater	M		Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999).	**High**. This species was recorded during field surveys.	**R**	**P**	**P**	**R**	**P**	**P**	**R**
Myiagra cyanoleuca	Satin Flycatcher	M		Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey & Knight 2007).	**Low**. Local records are likely only on an accidental basis.	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Neophema pulchella	Turquoise Parrot		V	Occurs in the foothills of the great dividing range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey. Nests in hollows in trees, stumps or even fence posts. It feeds on seeds of both native and introduced grass and herb species (Garnett & Crowley 2000).	**High**. This species was recorded during field surveys.	**R**	**R**	**R**	**R**	**P**	**P**	**R**
Ninox connivens	Barking Owl		V	Occurs in dry sclerophyll woodland. In the south west it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett & Crowley 2000).	**High**. This species was recorded during field surveys.	**P**	**P**	**P**	**N**	**R**	**P**	**P**
Polytelis swainsonii	Superb Parrot	V	V	Mainly found in the Riverina where they nest in loose colonies in riparian woodland on River Red Gum. On the inland slopes, Superb Parrots both forage and feed within box woodland, mostly nesting in dead trees (Garnett & Crowley 2000).	**Moderate**. Suitable habitats are available for this species.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Pomatostomus temporalis	Grey-crowned Babbler		V	Found throughout western slopes and plains, southern and central tablelands and occurring in Northern Rivers area, mid-north coast and the Hunter Valley of NSW. Lives in open forest and woodland, acacia shrubland and adjoining farmland. Large stick dome nest with spout-like entrance (Pizzey & Knight 2007).	**High**. This species was recorded during field surveys.	**R**	**R**	**R**	**R**	**R**	**R**	**P**
Pyrrholaemus sagittatus	Speckled Warbler		V	Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett & Crowley 2000).	**High**. This species was recorded during field surveys.	**R**	**R**	**R**	**R**	**R**	**R**	**R**
Stagonopleura guttata	Diamond Firetail		V	Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).	**High**. This species was recorded during field surveys.	**R**	**R**	**P**	**R**	**P**	**R**	**P**
Tyto novaehollandiae	Masked Owl		V	Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	**High**. This species was recorded during field surveys.	**P**	**P**	**P**	**R**	**P**	**P**	**P**
Xanthomyza phrygia	Regent Honeyeater	E,M	E1	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei* are important for feeding and breeding. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum) (Garnett & Crowley 2000).	**Moderate**. Suitable habitats are available for this species.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Native Mammals												

Scientific name	Common name	EPBC Act[1]	TSC/FM Act[2]	Preferred habitat[4]	Likelihood of occurrence	Recorded or predicted to occur in BOA[5]						
						Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 2008).	**Moderate**. Suitable foraging habitats are available for this species.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Chalinolobus picatus	Little Pied Bat		V	The species roosts in trees, caves, and abandoned mines and houses. Roost sites in caves are usually warm and dry but they can tolerate roost temperatures of more than 40 degrees 5elsius. The Little Pied Bat has been recorded in dry open forest, open woodland, Mulga woodlands, chenopod shrublands, Callitris forest and mallee (Churchill 2008).	**High**. This species was recorded during field surveys.	**P**	**P**	**P**	**R**	**P**	**P**	**P**
Dasyurus maculatus	Spotted-tailed Quoll	E	V	Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland. Nests in rock caves and hollow logs or trees (NSW National Parks and Wildlife Service 1999b, 1999d).	**Moderate**. Suitable habitats are available for this species.	**P**	**P**	**P**	**P**	**N**	**P**	**P**
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill 2008).	**High**. This species was recorded during field surveys.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Miniopterus schreibersii	Eastern Bent-wing Bat		V	Usually found in well-timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill 2008).	**High**. This species was recorded during field surveys.	**P**	**P**	**P**	**R**	**P**	**P**	**P**
Nyctophilus corbeni (formerly *Nyctophilus timoriensis*)	Corbens Long-eared Bat	V	V	Roosts in tree hollows and under loose bark in arid and semi-arid Australia (Strahan 1995) and forages in the understorey of woodlands and open savanna and swamps (Churchill 1998).	**High**. This species has previously been recorded in Leard State Forest.	**P**	**P**	**P**	**R**	**P**	**P**	**P**
Petaurus norfolcensis	Squirrel Glider		V	Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999c).	**Moderate**. Suitable habitats are available for this species.	**R**	**P**	**R**	**P**	**P**	**R**	**P**
Phascolarctos cinereus	Koala		V	Found in sclerophyll forest. Throughout NSW, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis (NSW National Parks and Wildlife Service 1999a, 2003).	**High**. This species was recorded during field surveys.	**P**	**P**	**R**	**R**	**P**	**P**	**P**
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat		V	Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species(Churchill 2008).	**High**. This species was recorded during field surveys.	**P**	**P**	**R**	**R**	**P**	**P**	**P**
Vespadelus troughtoni	Eastern Cave Bat		V	A cave-dwelling species found in eastern Australia from Cape York to NSW. They inhabit tropical mixed woodland and wet sclerophyll forests on the coast and the dividing range, but extend into drier forests on the western slopes (Churchill 2008).	**High**. This species was recorded during field surveys.	**P**	**R**	**R**	**R**	**P**	**P**	**P**

Scientific name	Common name	EPBC Act[1]	TSC/FM Act[2]	Preferred habitat[4]	Likelihood of occurrence	Recorded or predicted to occur in BOA[5]						
						Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine
Reptiles												
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	V	V	Most common in the granite country of the New England Tablelands. It is found on rocky hills with dry open eucalypt forest or woodland. It favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter (Department of Environment and Conservation 2005; NSW National Parks and Wildlife Service 2002; Royal Botanic Gardens 2005).	**Moderate**. Suitable habitats are available for this species.	**P**	**P**	**P**	**P**	**P**	**P**	**P**
Hoplocephalus bitorquatus	Pale-headed Snake		V	A partly arboreal, nocturnal species found in a range of habitats from rainforest and wet sclerophyll forest to the drier eucalypt forests of the western slopes. Feeds largely on frogs and lizards (Cogger 2000).	**High**. This species has previously been recorded within Leard State Forest.	**P**	**P**	**P**	**P**	**P**	**P**	**P**

Notes:
1: Listed as Migratory (M), Endangered (E) of Vulnerable (V) under the EPBC Act
2. Listed as Endangered (E1), an Endangered Population (E2) or Vulnerable (V) under the TSC Act. † - Preliminary listed species
3. Recorded during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010).
4. Based on database searches and field surveys
5. (R) - Recorded in the BOAs, (P) - Moderate of greater likelihood of occurrence, (N) - Not recorded or predicted to occur within the BOAs
6. White-browned Woodswallow was a preliminary listing and has not been listed as a threatened species on the TSC Act

Appendix E

BOA management plans

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E1. Boggabri Coal Biodiversity Offset Areas

This section provides a background overview of Boggabri Coal's ten Biodiversity Offset Areas (BOAs) (Figure E-1) which include:

- Braefield
- Sunshine
- Nioka North
- Mallee
- Myall Plains
- Wirrilah
- Goonbri
- Jerralong
- Namoi
- Merriendi.

These ten BOAs have been further separated into four management areas based broadly on their location in the landscape and management measures they require (Figure E-1). These four management areas include:

- Eastern Offsets – Braefield, Sunshine, Nioka North BOAs
- Central Offsets – Mallee, Myall Plains, Wirrilah and Goonbri BOAs
- Namoi Offsets – Jerralong and Namoi BOAs
- Western Offsets – Merriendi BOA.

Implementation of management measures required within each of these areas are provided in detail in Section 2.

A summary of the vegetation, fauna habitat and habitat management zones across the four management areas has been provided below in Table E-1, Table E-2 and Table E-3 respectively. For further details regarding these attributes refer to the breakdown of each BOA provided in section below.

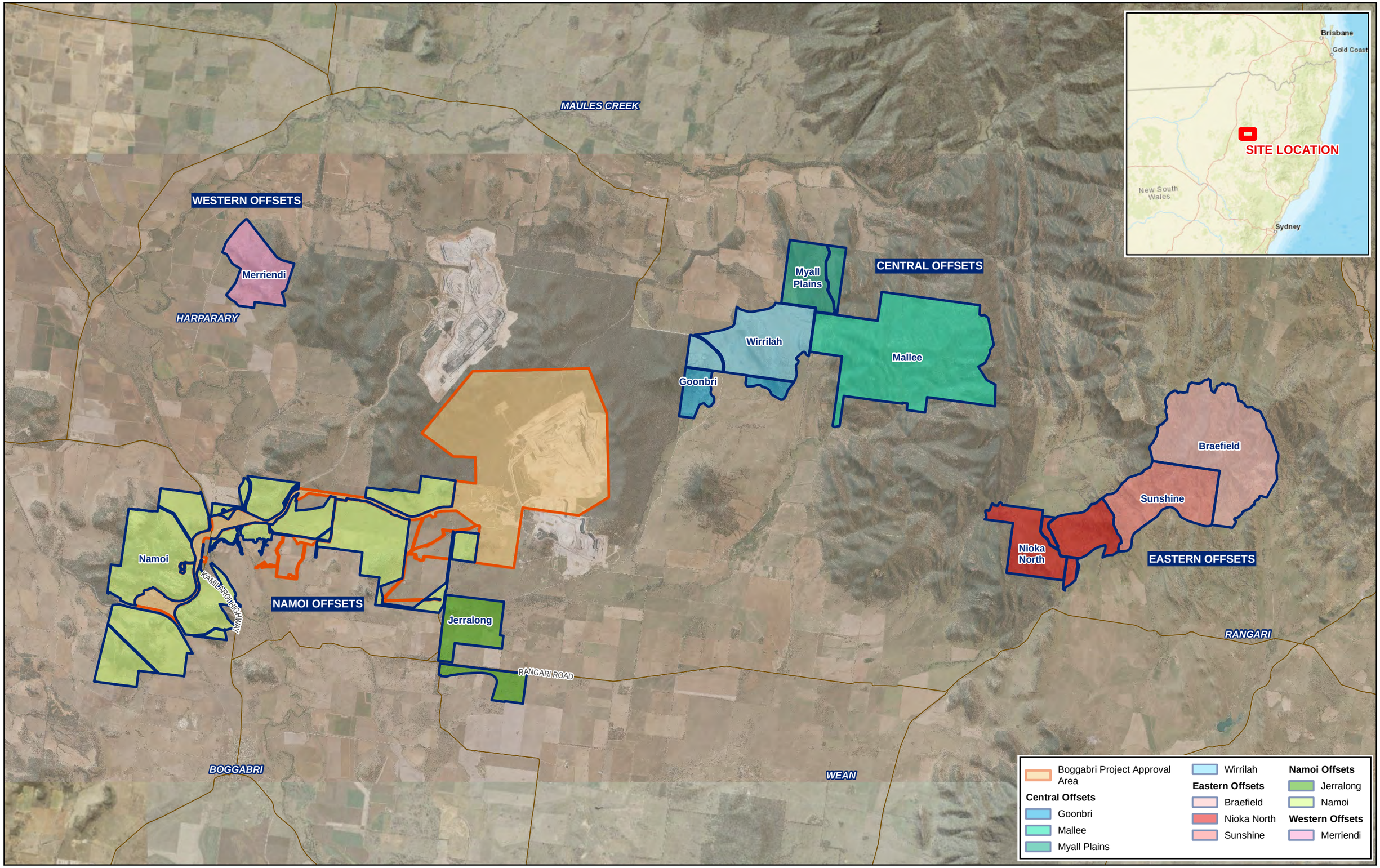
Offset security

The long-term objective of the Boggabri Coal BOS is to provide conservation of the area in-perpetuity. There are a number of options available to secure land under permanent conservation agreements. Boggabri Coal is committed to exploring and identifying the most suitable conservation arrangement for land in consultation with the relevant stakeholders. Potential options may include:

- BioBanking
- Voluntary Conservation Agreement
- dedication to National Parks reserve estate.

It should be recognised that a number of different conservation strategies to provide for the ongoing protection of offsets may be required and one strategy may not be suitable for all land tenures. Boggabri Coal is committed to establishing suitable conservation agreements for offsets to meet the objectives of the Boggabri Coal BOS and provide a regional approach to biodiversity conservation.

The overall objective of managing the BOAs is to achieve the designated success criteria. Following achievement of the completion criteria, discussions will be held with regulatory authorities to determine management responsibilities and potential land transfer arrangements.



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Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018); Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri

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DATE.	6/09/2018

APPENDIX E-1

TITLE. BOGGABRI COAL BIODIVERSITY OFFSETS AND MANAGEMENT AREAS

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Table E-1 Vegetation and Plant Community Types within the four offset zones

Vegetation community	Plant Community Type[1]	Total project disturbance (ha)[2]	Eastern offset (ha)	Central offset (ha)	Namoi offset (ha)	Western offset (ha)	Total (ha)
Threatened Ecological communities							
White Box Grassy Woodland (EEC - White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland[3, 4])	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383)	626.1	349.4	260.7	308.5	176.1	1,094.7
	Derived Native Grassland	4.1	566.4	613.0	561.2	150.5	1,891.1
Yellow Box - Blakely's Red Gum grassy woodland (EEC - White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland[3, 4])	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (NA 237, PCT 1329)	3.2	73.3	33.9	17.9	–	129.6
	Derived Native Grassland	0.0	–	36.7	28.9	–	65.6
White Box Blakely's Red Gum Rough-barked Apple riparian woodland (EEC - White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland[3, 4])	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (grassy variant) (NA 197, PCT 1118)	0.0	303.6	–	–	–	303.6
	Derived Native Grassland	0.0	3.0	–	–	–	3.0
Weeping Myall Woodland (EEC – Weeping Myall Woodland[5, 6])	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (NA 219, PCT 027)	0.4	–	–	30.2	1.6	31.8

Vegetation community	Plant Community Type[1]	Total project disturbance (ha)[2]	Eastern offset (ha)	Central offset (ha)	Namoi offset (ha)	Western offset (ha)	Total (ha)
	Derived Native Grassland	0.0	–	–	2.3	–	2.3
River Red Gum Riparian woodland and forest (EEC – Natural Drainage System of the Lowland Catchment of the Darling River (River Red Gum Riverine Woodlands)[7])	River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 193, PCT 078)	2.8	–	–	68.6[10]	–	68.6[10]
	Derived Native Grassland	0.0	–	–	94.0	–	94.0
Plains Grassland (EEC – Plans Grassland[8, 9])	Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion (NA 181, PCT 102)	0.5	–	–	20.3	–	20.3
Sub-total threatened ecological communities		**637.1**	**1,295.7**	**948.8**	**1,131.9**	**328.2**	**3704.6**
Other Vegetation communities							
Pilliga Box - Poplar Box - White Cypress Pine grassy open woodland	Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion (NA 179, PCT 88)	46.9	–	–	417.3	–	417.3
	Derived Native Grassland	38.1	–	–	832.4	4.4	836.8
Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest	Narrow-leaved Ironbark – pine Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion (NA 163, PCT 1380)	14.8	NA[11]	NA[11]	NA[11]	NA[11]	0
Narrow-leaved Ironbark - White	White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313)	532.3	–	2,040.3	178.8	–	2,219.1

Vegetation community	Plant Community Type[1]	Total project disturbance (ha)[2]	Eastern offset (ha)	Central offset (ha)	Namoi offset (ha)	Western offset (ha)	Total (ha)
Cypress Pine shrubby open forest	Derived Native Grassland	0.0	–	23.5	23.8	–	47.3
White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)	182.8	438.3	237.1	444.4	20.4	1,140.2
White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (shiny bush) Regrowth – White Cypress Pine	Derived Native Grassland	0.0	–	103.5	7.0	–	110.5
Belah alluvial woodlands	Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region (NA 102, PCT 055)	0.0	–	–	2.7	–	2.7
	Derived Native Grassland	0.0	–	–	65.3		65.3
Silver-leaved Ironbark heathy woodland	White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (NA 224, PCT 1307)	3.7	6.8	20.6	203.8	–	231.2
	Derived Native Grassland	0.0	4.4	–	3.5	–	7.9
Dwyer's Red Gum Woodland (including regrowth White Cypress Pine)	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (NA 2415, PCT 610)	0.3	43.6	91.4	125.4	130.2	390.6
	Derived Native Grassland	0.0	–	–	29.2	–	29.2

Vegetation community	Plant Community Type[1]	Total project disturbance (ha)[2]	Eastern offset (ha)	Central offset (ha)	Namoi offset (ha)	Western offset (ha)	Total (ha)
White Box – White Cypress Pine shrubby open forest (including White Cypress Pine regrowth and Shiny Bush)	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA 225, PCT 1308)	0.0	896.7	–	–	–	896.7
Rough-barked Apple Riparian Forb/Grass Open Forest	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (NA 197, PCT 1118)	0.0	163.1	16.8	7.9	–	187.8
River Oak Riparian Open Forest	River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions (NA 191, PCT 84)	0.0	17.0	14.7	4.6	–	36.3
Tumbledown Red Gum grassy woodland Myrtle Shrubland (+/- White Pine/Tumbledown Red Gum)	Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion (NA 410, PCT 427)	0.0	26.4	142.9	–	–	169.3
New England Blackbutt Rough-barked Apple shrubby open forest	Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion	0.0	1.3	–	–	–	1.3
Intensive Agriculture Exotic Grassland	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	0.0	102.0	15.1	30.3	–	147.4
Farm dams	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)	0.0	1	–	–	–	1.0
Sub-total other vegetation communities		**818.9**	**1,700.6**	**2,705.9**	**2,376.4**	**155.0**	**6,937.9**

Vegetation community	Plant Community Type[1]	Total project disturbance (ha)[2]	Eastern offset (ha)	Central offset (ha)	Namoi offset (ha)	Western offset (ha)	Total (ha)
Total		**1,456.0**	**2,996.3**	**3,654.7**	**3,508.3**	**483.2**	**10,642.5**

(1) Plant Community Type is a NSW classification established to provide unambiguous master community-level classification for use in vegetation mapping programs, BioMetric-based regulatory decisions, and as a standard typology for other planning and data gathering programs.
(2) Total Project disturbance includes impacts associated with the Continuation of Boggabri Coal Environmental Assessment, Modification 3, Modification4, Modification 5, inadvertent clearing outside Project Boundary and Goonbri Road Upgrade.
(3) Critically Endangered Ecological Community White Box – Yellow Box – Blakey's Red Gum Woodland and Derived Native Grassland listed under the EPBC Act.
(4) Endangered Ecological Community White Box – Yellow Box – Blakely's Red Gum Woodland listed under the TSC Act.
(5) Endangered Ecological Community Weeping Myall Woodlands listed under the EPBC Act.
(6) Endangered Ecological Community Myall Woodland in the Darling Riverine Plains, Brigalow belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions listed under the TSC Act.
(7) Endangered Ecological Community Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River listed under the FM Act.
(8) Critically Endangered Ecological Community Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland.
(9) Endangered Ecological Community Native Vegetation on Cracking Clay Soils of the Liverpool Plains listed under the TSC Act.
(10) A deficit of 8.0 ha is associated with River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA193, PCT78). This is fulfilled by surplus credits from River Red Gum riparian tall woodland/ open forest wetland (Derived Native Grassland) in the Namoi BOA (refer Table 4.3).
(11) The deficit for Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion (NA 163, PCT 1380) is accounted for in the 2,106.6 ha of proposed offset area associated with White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313).
(12) Identified for corridor enhancement (intensive management).

Table E-2 Fauna habitat types within the four management areas

BOA	Grassy Woodland	Shrubby woodland	Riverine	Grassland	Intensive agriculture	Total
Eastern Offsets						
Nioka North	176.4	278.6	115.1	269.6	17.9	857.6
Sunshine	81.2	151.8	171.5	248.8	84.7	738
Braefield	165.1	982.7	197.1	55.4	0.4	1,400.7
Sub-total	**422.7**	**1,413.1**	**483.7**	**573.8**	**103**	**2,996.3**
Central Offsets						
Mallee	14.2	1,992.8	18.9	40.3	0	2,066.2
Myall Plains	66.5	300.9	0	62	43.9	473.3
Wirrilah	146.1	183.3	12.6	356.6	185.6	884.2
Goonbri	72.3	55.3	0	88.3	15.1	231
Sub-total	**299.1**	**2,532.3**	**31.5**	**547.2**	**244.6**	**3,654.7**
Namoi Offsets						
Namoi	567.6	939	81.1	1368.9	258.3	3,214.9
Jerralong	209	13.4	0	300.8	46.9	570.1
Sub-total	**776.6**	**952.4**	**81.1**	**1,669.7**	**305.2**	**3,785**
Western Offsets						
Merriendi	177.7	150.6	0	154.9	0	483.2
Sub-total	**177.8**	**150.6**	**0**	**154.9**	**0**	**483.3**
Total all offsets areas	**1,676.1**	**5,048.4**	**596.3**	**2,945.6**	**652.8**	**10,919.2**

(1) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.

Table E-3 Habitat management zones within the four management areas

BOA	Habitat management zone	Habitat restoration zone	Corridor enhancement zone	Other land for agriculture	Total
Eastern Offsets					
Nioka North	523.1	316.6	17.9	0	857.6
Sunshine	353.2	300.1	84.7	0	738
Braefield	1,283.20	117.1	0.4	0	1400.7
Sub-total	**2,159.5**	**733.8**	**103**	**-**	**2,996.3**

BOA	Habitat management zone	Habitat restoration zone	Corridor enhancement zone	Other land for agriculture	Total
Central Offsets					
Mallee	2,025.90	40.3	0	0	2066.2
Myall Plains	367.4	62	43.9	0	473.3
Wirrilah	326.8	371.8	185.6	0	884.2
Goonbri	127.6	88.3	15.1	0	231
Sub-total	**2,847.7**	**562.4**	**244.6**	**-**	**3,654.7**
Namoi Offsets					
Namoi[1]	1,563.4	1,391.4	30.3	229.8	3,214.9
Jerralong	222.4	300.8	-	46.9	570.1
Sub-total	**1,785.8**	**1,692.2**	**30.3**	**276.7**	**3,785.0**
Western Offsets					
Merriendi	327.0	156.2	-	-	483.2
Sub-total	**327.0**	**156.2**	**-**	**-**	**483.2**
Total all offsets	**7,120.0**	**3,144.6**	**377.9**	**276.7**	**10,919.2**

(1) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.

E1.1 Eastern Offsets

E1.1.1 Nioka North BOA

The Nioka North BOA encompasses an area of 857.6 ha and is located approximately 16.5 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Nioka North BOA is provided in Table E-4 and the site locality is illustrated in Figure E-1.

Table E-4 Summary of Nioka North BOA

Criteria	Location
Council	Narrabri Shire Council and Gunnedah Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Narrabri

E1.1.1.1 Baseline condition

The Nioka North BOA lies within the Nandewar Range and forms part of the eastern section of the Regional East-West Wildlife Corridor. The most intact areas of woodland habitat occur in the west and far east of the Nioka North BOA, although understorey vegetation exhibits the effects of grazing on the lower slopes. Large remnant intact native vegetation occurs on the ridges in the south west linking the BOA to larger areas intact native vegetation extending the north and south. Elsewhere throughout the property remnant woodland trees are largely scattered or form residual patches along drainage lines or regrowth covering on hills. The vegetation and fauna habitat types present are illustrated in Figure E-2 and a breakdown is provided in Table E-5 and Table E-6.

Table E-5 Vegetation types within the Nioka North BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Total Area (ha)
Dwyer's Red Gum Woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	4.3
Rough-barked Apple – White Box Shrubby Woodland	PCT1308 / BVT NA225 White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	11.7

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Total Area (ha)
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland[1]	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	115.1
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest, White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Shiny Bush), White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Callitris Regrowth)	PCT1381 / BVT NA 165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	262.6
White Box Grassy Woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	115.9
White Box Grassy Woodland (low condition – Derived Native Grassland) [2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions Derived native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	265.2
Yellow Box – Blakely's Red Gum Grassy Woodland[1]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	60.5
Silver-leaved Ironbark heathy woodland (Low condition)	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	4.4

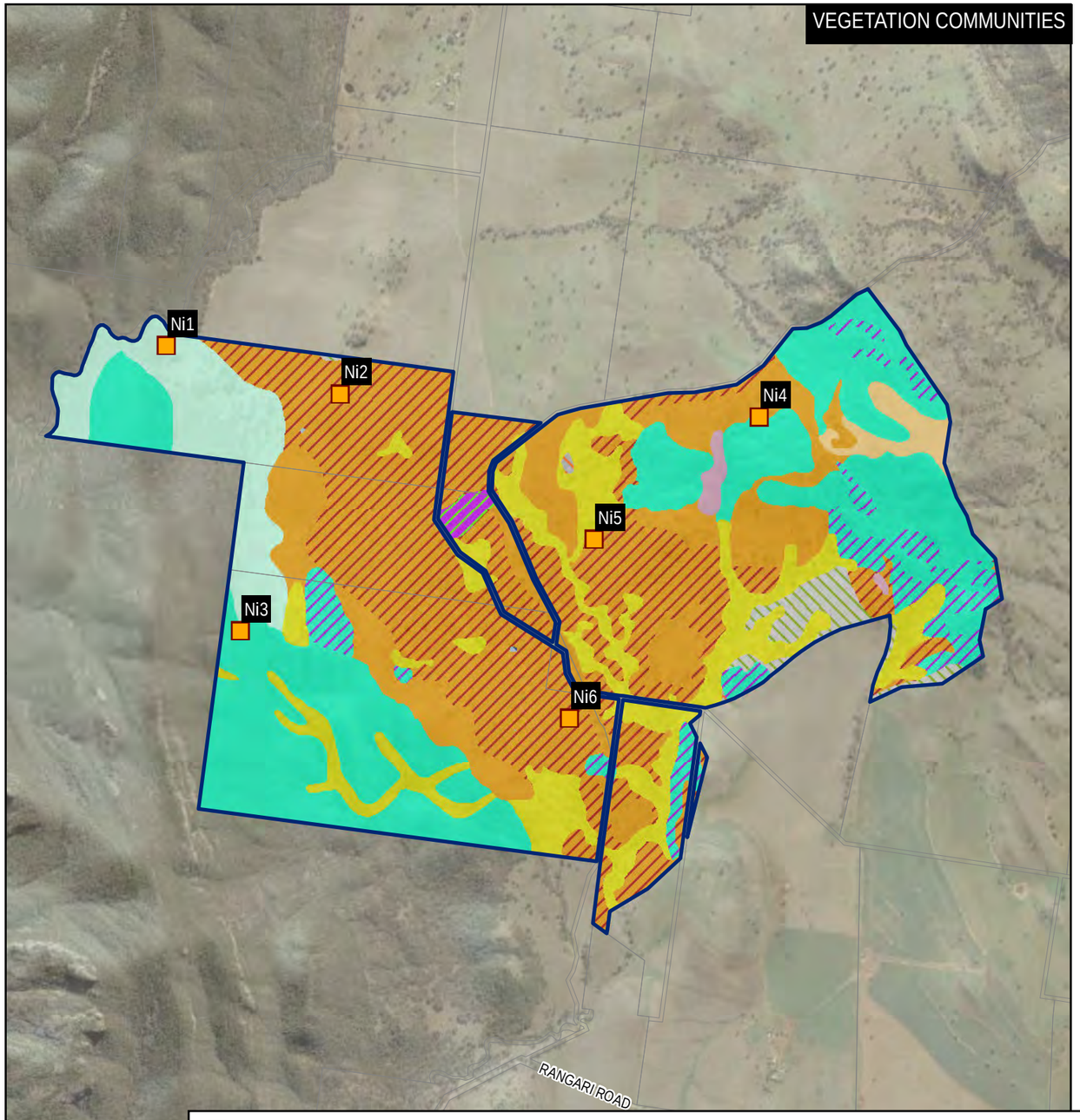
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Total Area (ha)
Other land (intensive agriculture)	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	17.7
Farm dams	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)	n/a	n/a	Not listed	0.2
Total					**857.6**

Notes:
1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland BC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

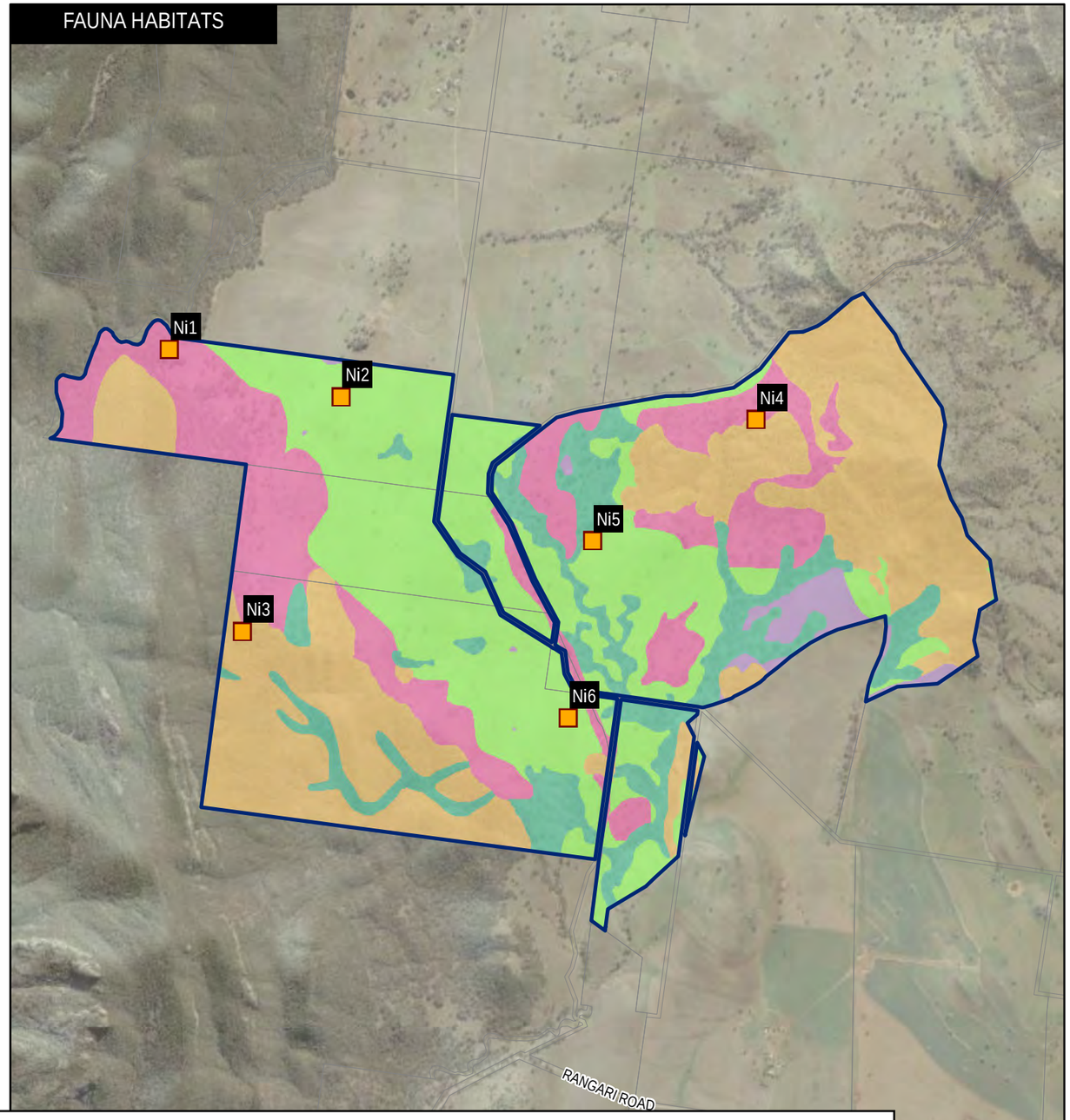
Table E-6 Fauna habitat types within the Nioka North BOA

Fauna habitat	Area (ha)
Grassland / Pasture	269.6
Grassy woodland on fertile soils	176.4
Shrubby woodlands / Open forest on skeletal soils	278.6
Riverine Woodland	115.1
Intensive agriculture and farm dams	17.9
Total	**857.6**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion - Derived Native Grassland [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

0 250 500 Metres

Scale 1:27,500

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
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APPENDIX E-2

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE NIOKA NORTH BOA

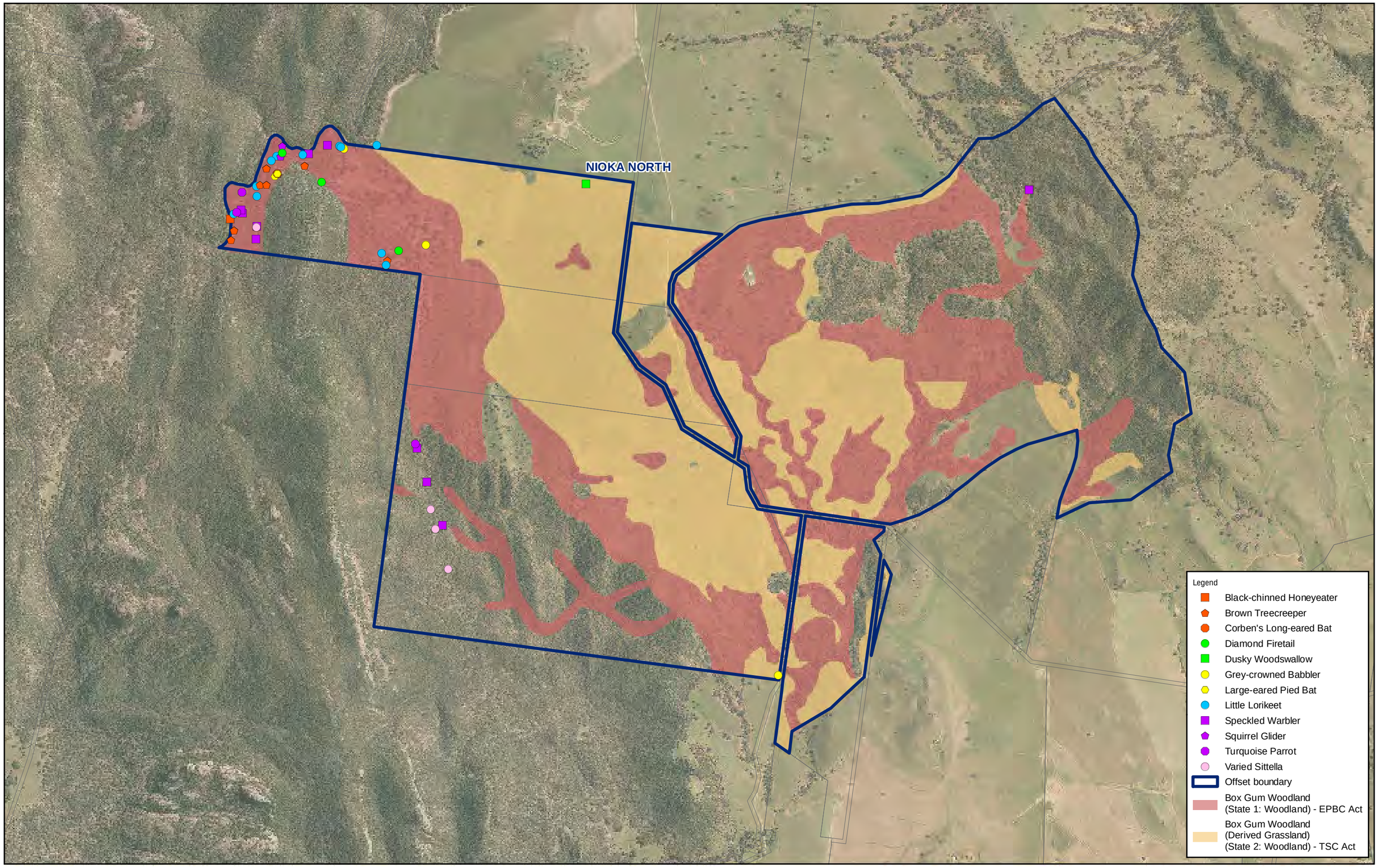
Table E-7 summarises the threatened species recorded or predicted to occur within the Nioka North BOA. Threatened species and ecological communities recorded within the Nioka North BOA are illustrated in Figure E-3.

Table E-7 Threatened species recorded or predicted to occur within the Nioka North BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Picris evae	V	V	
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	E	-	
Tylophora linearis	E	V	
Pomaderris queenslandica	-	E1	
Fauna			
Birds			
Black-chinned Honeyeater		V	Recorded
Brown Treecreeper		V	
Diamond Firetail		V	
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Little Lorikeet		V	
Speckled Warbler		V	
Turquoise Parrot		V	
Varied Sittella		V	
Hooded Robin		V	Potential habitat
Painted Honeyeater		V	
Barking Owl		V	
Regent Honeyeater	CE	CE	
Swift Parrot	CE	E1	
Pied Honeyeater		V	
Masked Owl		V	
Little Eagle		V	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Mammals			
Squirrel Glider		V	Recorded

Species	EPBC Act[1]	BC Act[2]	Note
Corben's Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Eastern Cave Bat		V	Potential habitat
Eastern Bent-wing Bat		V	
Yellow-bellied Sheathtail Bat		V	
Little Pied Bat		V	
Eastern False Pipistrelle		V	
Spotted-tailed Quoll	V	V	
Koala	V	V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential Habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E), Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act



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APPENDIX E-3

TITLE. IMPLEMENTATION MEASURES FOR THE NIOKA NORTH BOA

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Baseline habitat conditions for matters of National Environmental Significance

The Nioka North BOA contains approximately 291.5 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland as per the methodology set out in Section 6.2.1 of main BMP document. A further 265.2 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the BC Act listing for this community. This ecological community is situated throughout the Nioka North BOA on lower slopes and flatter land (Figure E-3).

Corben's Long-eared Bat and Large-eared Pied Bat, which are listed as Vulnerable under the EPBC Act, have been recorded in the Nioka North BOA. In addition, the Nioka North BOA provides suitable habitat for the Grey-headed Flying-fox, Regent Honeyeater, Swift Parrot and Superb Parrot.

E1.1.1.2 Planning

Completion criteria

The completion criteria for management of the Nioka North BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Nioka North BOA contains three offset management zones, as detailed Table E-8 and illustrated in Figure E-4.

Table E-8 Offset management zones within the Nioka North BOA

Offset management zone	Area (ha)
Habitat management zone	523.1
Habitat restoration zone	316.6
Corridor enhancement zone	17.9
Total	**857.6**

Threats and disturbances

Existing threats and disturbances within the Nioka North BOA include:

- Clearing and fragmentation — a large proportion of the lower slopes within Nioka North BOA has been historically cleared and are now dominated by low condition woodland, derived native grassland and exotic dominated pasture (Figure E-2).
- Livestock grazing — the Nioka North BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the property, thereby promoting weed growth.
- Weedy exotic plants and pest animals – the Nioka North BOA contains areas of low to moderate pasture weed invasions within the grassland areas, in the south eastern and middle portion of the property where grazing is intensified (Figure E-34). Minor weed control will be required throughout the pasture areas.
- Invasion of native shrub species (i.e. *Dodonea viscosa, Beyeria viscosa, Oleria elliptica*). Dense thickets of these three species occur on the cleared hill tops and upper slopes throughout the BOA (Figure E-34). A specific management intervention will be required to prevent further spread of these shrubs throughout the property.

- Invasion of native Callitris species (i.e. *Callitris glaucophylla*). There are several areas within the east of the BOA which contain thickets of Callitris species (Figure E-34). Management of these areas will be required to prevent further spread of this species and increase native diversity.
- Alteration of abiotic factors (hydrology, nutrients and soil) - The Nioka North BOA contains several large ephemeral drainage lines. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities.
- Pesticides and herbicides — areas of remnant native vegetation within the property may be subjected to spray drift or chemical run-off from adjoining agricultural land from the south east and the north west.

NIOKA NORTH

Ni1
Ni2
Ni3
Ni4
Ni5
Ni6

Legend
- Ecological survey locations
- Offset boundary
- Corridor enhancement zone
- Habitat management zone
- Habitat restoration zone

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Imagery:
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APPENDIX E-4

TITLE. IMPLEMENTATION MEASURES FOR THE NIOKA NORTH BOA

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E1.1.2 Sunshine BOA

The Sunshine BOA encompasses an area of 738.0 ha and is located approximately 18 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Sunshine BOA is provided in Table E-9 and the site locality is illustrated in Figure E-1.

Table E-9 Summary of Sunshine BOA

Criteria	Location
Council	Gunnedah Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Gunnedah

E1.1.2.1 Baseline condition

The Sunshine BOA lies within the Nandewar Range and forms part of the south-eastern portion of the Regional East-West Wildlife Corridor. Much of the woodland within the Sunshine BOA occurs in fragmented landscape. Regeneration is present on many parts of the BOA throughout the northern uplands, particularly along ridgetops and drainage lines. The vegetation and fauna habitat types present are illustrated in Figure E-5 and a breakdown is provided in Table E-10 and Table E-11 respectively.

Table E-10 Vegetation types within the Sunshine BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
Dwyer's Red Gum Woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	1.3
Rough-barked Apple – White Box shrubby/grassy woodland	PCT1308 / BVT NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	5.1
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland[1]	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (grassy variant)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	159.3
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland	3.0

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
(Derived Native Grassland)[2]				(BC Act & EPBC Act)	
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland (Shrubby variant)	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (shrubby variant)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	12.2
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Shiny Bush)	PCT1381 / NA165. Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	138.6
White Box Grassy Woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	81.2
White Box Grassy Woodland (Low condition – Derived Native Grassland) [2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived Native Grassland) [2]	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	245.8
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	6.8
Exotic grassland (intensive agriculture)	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	84.3
Farm dams	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)	n/a	n/a	-	0.4
Total					**738.0**

Notes:

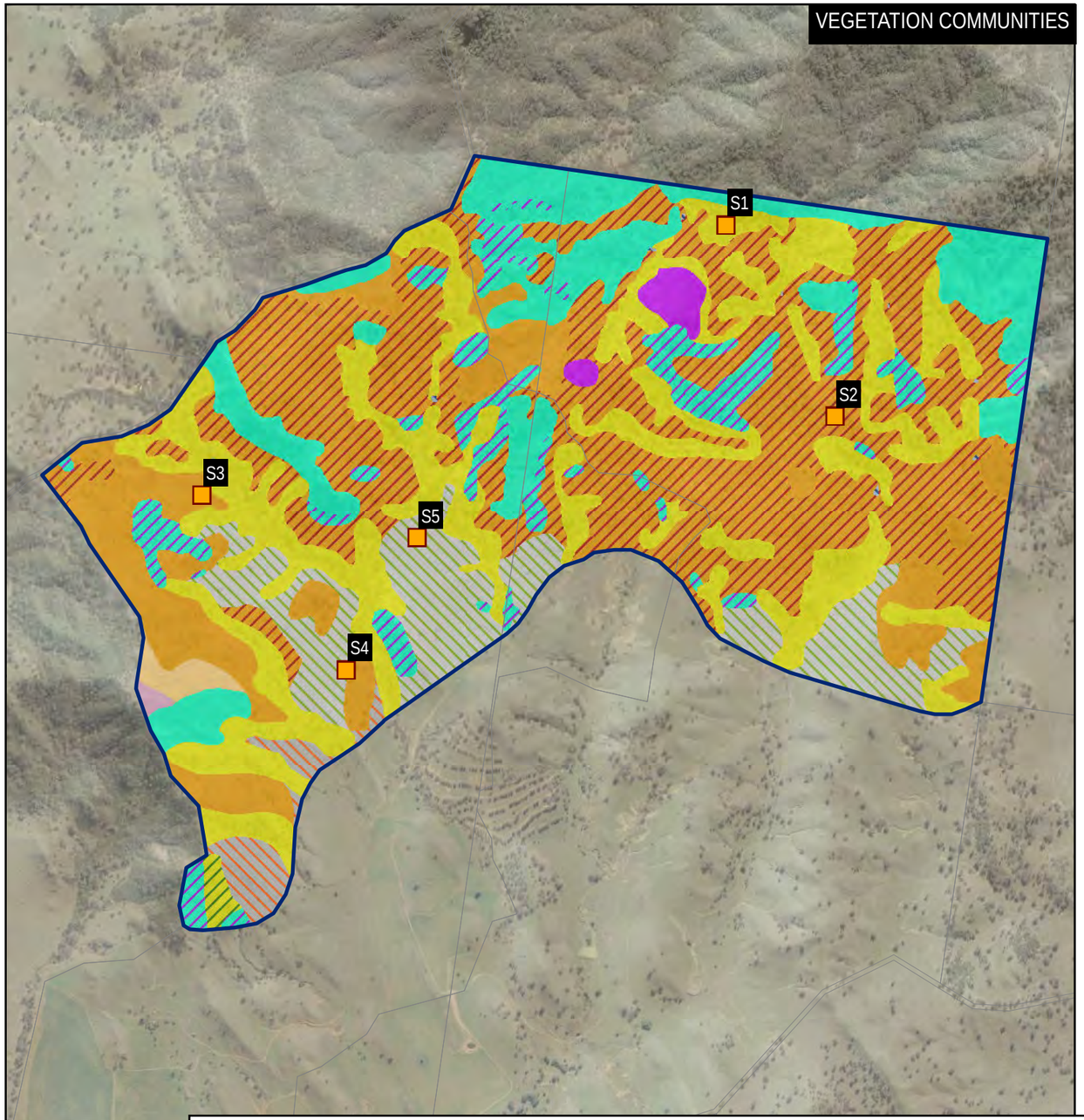
1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

2 Commensurate with State 2 Derived Native Grassland BC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

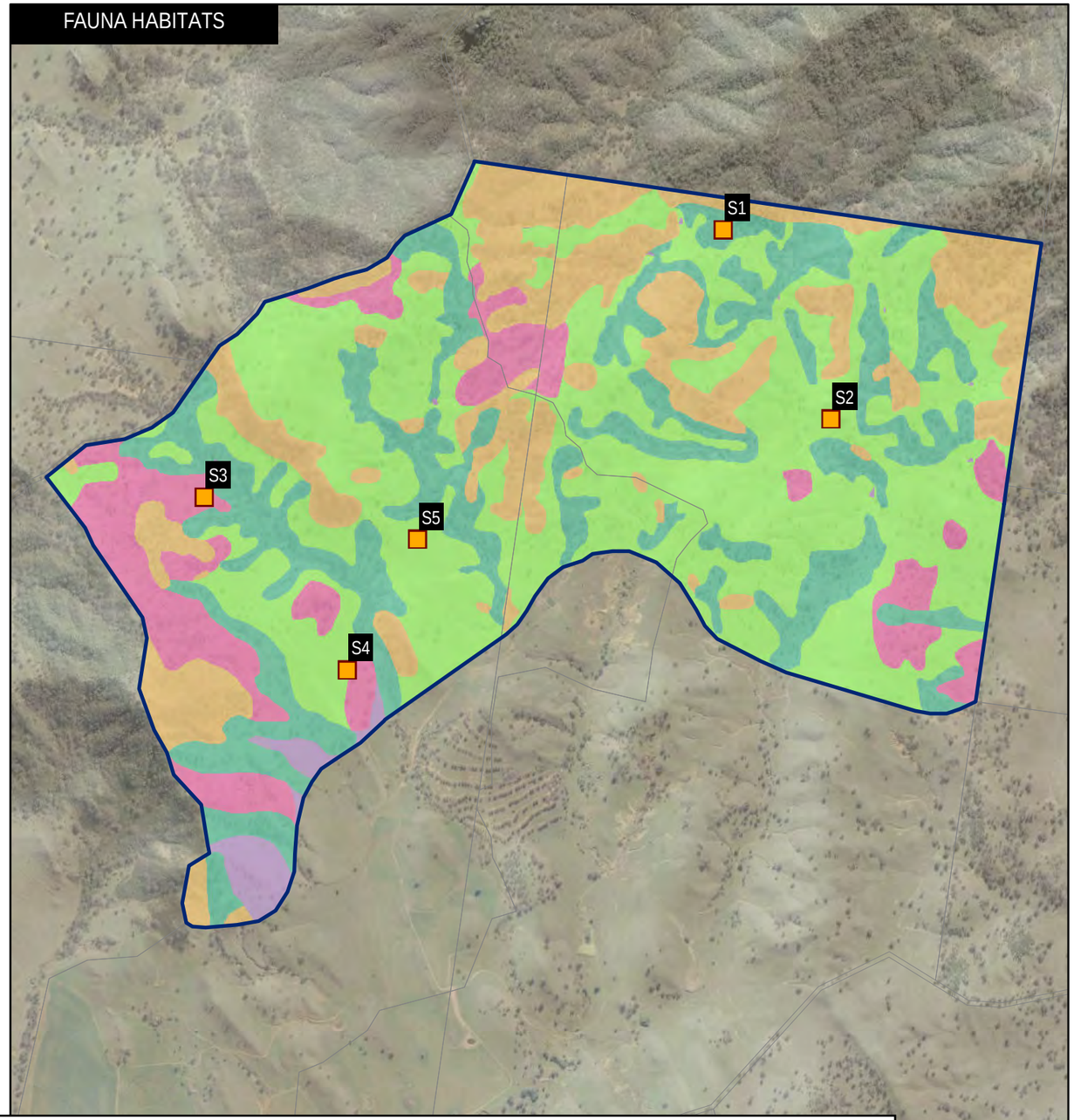
Table E-11 Fauna habitat types within the Sunshine BOA

Fauna habitat	Area (ha)
Grassland / Pasture	248.8
Grassy woodland on fertile soils	81.2
Shrubby woodlands/Open forest on skeletal soils	151.8
Riverine woodland	171.5
Intensive agriculture and farm dams	84.7
Total	**738.0**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion - Derived grassland [PCT1118/NA197]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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APPENDIX E-5

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE SUNSHINE BOA

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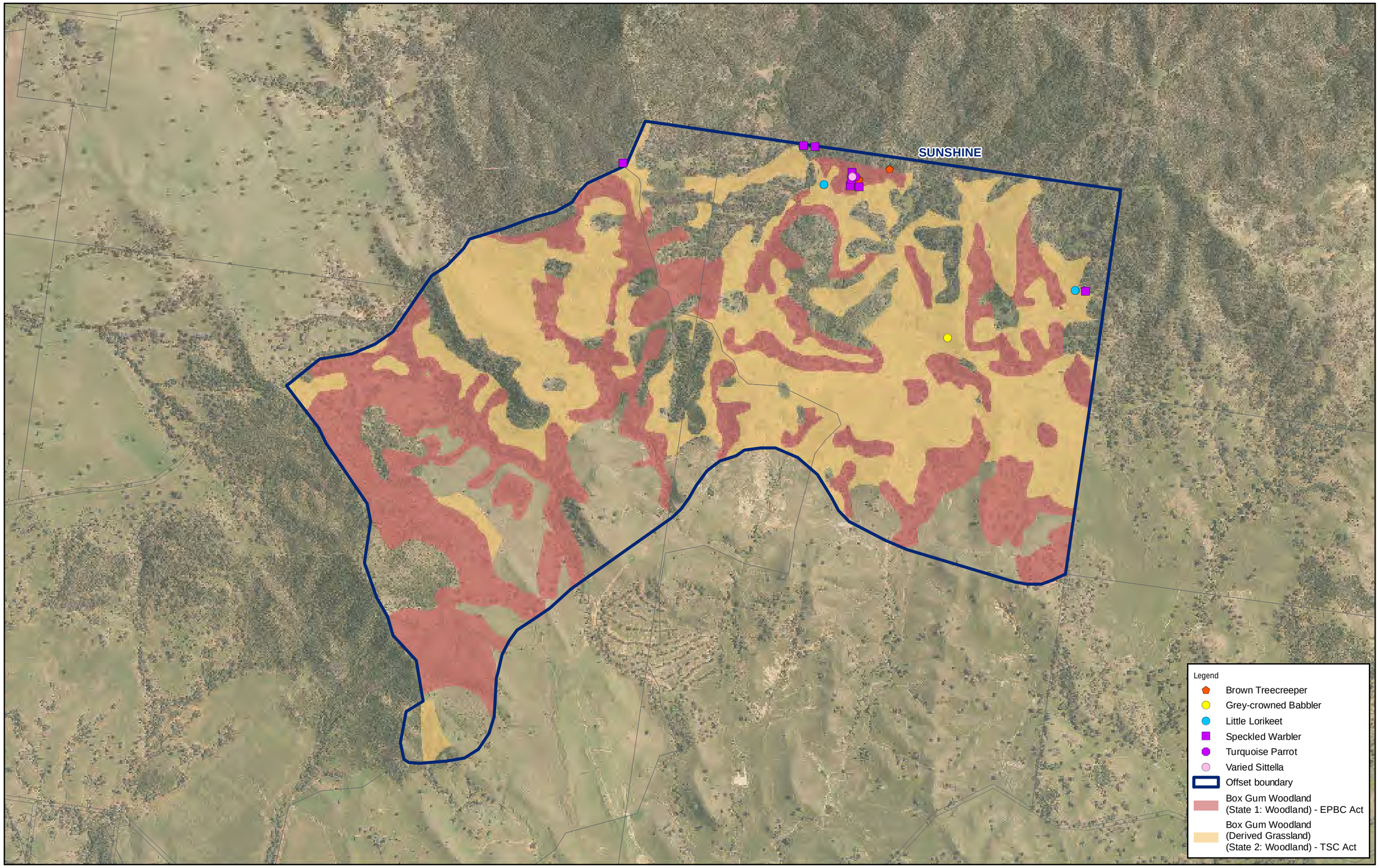
Table E-12 summarises the threatened species recorded or predicted to occur within the Sunshine BOA. Threatened species and ecological communities recorded within the Sunshine BOA are illustrated in Figure E-6.

Table E-12 Threatened species recorded or predicted to occur within the Sunshine BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria Porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Pomaderris queenslandica	-	E1	
Tylophora linearis	E	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Little Lorikeet		V	
Rainbow Bee-eater	M		
Speckled Warbler		V	
Turquoise Parrot		V	
Grey-crowned Babbler		V	
Dusky Woodswallow		V	
Black-chinned Honeyeater		V	Potential habitat
Barking Owl		V	
Diamond Firetail		V	
Hooded Robin		V	
Masked Owl		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Mammals			
Eastern Cave Bat		V	Potential habitat
Eastern Bent-wing Bat		V	
Yellow-bellied Sheathtail Bat		V	
Little Pied Bat		V	

Species	EPBC Act[1]	BC Act[2]	Note
Eastern False Pipistrelle		V	
Corbens Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	V	V	
Squirrel Glider		V	
Koala		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E), Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act



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DATE.	7/09/2018

APPENDIX E-6

TITLE. IMPLEMENTATION MEASURES FOR THE SUNSHINE BOA

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Baseline habitat conditions for matters of National Environmental Significance

The Sunshine BOA contains approximately 240.5 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland as per the methodology set out in Section 6.2.1 of main BMP document. A further 248.8 ha of derived native grassland that meets BC Act and meets State 2 native pastures. This ecological community is situated throughout the Sunshine BOA on lower slopes and flatter land (Figure E-6).

The Sunshine BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox, Corben's Long-eared Bat and Large-eared Pied Bat.

E1.1.2.2 Planning

Completion criteria

The completion criteria for management of the Sunshine BOA are provided in Section 7.3of the main BMP document.

Offset management zones

The Sunshine BOA contains three offset management zones, as detailed in Table E-13 and illustrated in Figure E-7.

Table E-13 Offset management zones within the Sunshine BOA

Offset management zone	Area (ha)
Habitat management zone	353.2
Habitat restoration zone	300.1
Corridor enhancement zone	84.7
Total	**738.0**

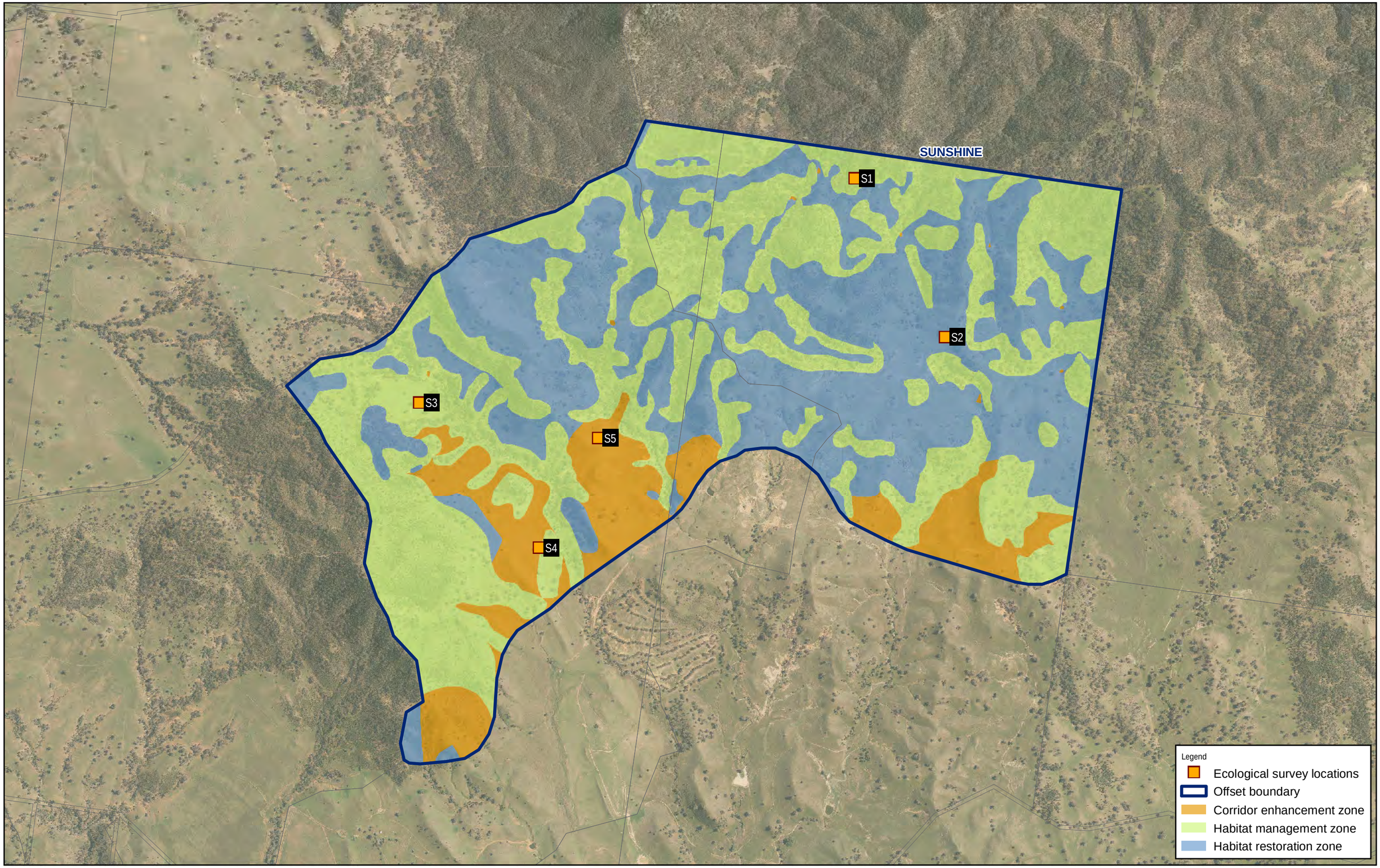
Threats and disturbances

Existing threats and disturbances within the Sunshine BOA include:

- Clearing and fragmentation — a large proportion of the Sunshine BOA has been historically cleared with large areas dominated by low condition woodland, derived native grassland, exotic dominated pasture or agricultural crops (Figure E-5).
- Livestock grazing - the Sunshine BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the property, thereby promoting weed growth.
- Weedy exotic plants and pest animals — the Sunshine BOA contains areas of high weed density, particularly within the south and eastern area of the property, where grazing is intensified (Figure E-35). Without management intervention, weed densities within this area may increase and potentially spread into low density weed areas throughout the property. Pest animals were observed throughout the property including Goats, rabbits, pigs and foxes.
- Invasion of native shrub species (i.e. *Dodonea viscosa, Beyeria viscosa, Oleria elliptica*). Dense thickets of these three species occur on the cleared hill tops and upper slopes throughout the BOA (Figure E-34). A specific management intervention will be required to prevent further spread of these shrubs throughout the property.
- Alteration of abiotic factors (hydrology, nutrients and soil) - The Sunshine BOA contains several large ephemeral drainage lines. These drainage lines are currently contain high

level erosion in some areas. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities. Figure E-34 provides locations/areas which require target erosion control.

- Pesticides and herbicides — areas of remnant native vegetation within the property may be subjected to spray drift or chemical run-off from adjoining agricultural land from the north west and south.



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APPENDIX E-7

TITLE. IMPLEMENTATION MEASURES FOR THE SUNSHINE BOA

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E1.1.3 Braefield BOA

The Braefield BOA encompasses an area of 1,400.7 ha and is located approximately 20 km east of the EIS mine disturbance limit (Boggabri Existing). A summary of the Braefield BOA is provided in Table E-14 and the site locality is illustrated in Figure E-1.

Table E-14 Summary of Braefield BOA

Criteria	Location
Council	Gunnedah Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Keepit Slopes and Plains
Noxious weed control area	Gunnedah

E1.1.3.1 Baseline condition

The Braefield BOA lies within the Nandewar Range and forms part of the south-eastern portion of the Regional East-West Wildlife Corridor. The Braefield BOA contains over 1400.7 ha of native vegetation including high quality remnant vegetation, particularly in the north, which will complement and adjoin high quality existing vegetation and will extend the Regional East-West Wildlife Corridor. An important environmental corridor that historically linked Leard State Forest with the Nandewar Range, Namoi River and large vegetation remnants to the west. The vegetation and fauna habitat types present are illustrated in Figure E-8 and a breakdown is provided in Table E-15 and Table E-16 respectively.

Table E-15 Vegetation types within the Braefield BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
Tumbledown Red Gum grassy woodland	PCT427 / BVT NA410: Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion		Semi-arid Woodlands (Shrubby sub-formation)	Not listed	26.4
White Box Blakely's Red Gum Rough-barked Apple riparian forest (shrubby variant)	PCT1118 / NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (shrubby variant)	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	150.9
White Box Blakely's Red Gum Rough-barked Apple riparian woodland[1]	PCT1118 / NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (grassy variant) [1]	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	29.2
White Box Grassy Woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the	Western Slopes	Grassy Woodlands	White box – Yellow Box – Blakely's	152.3

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
	Nandewar Bioregion and Brigalow Belt South Bioregion	Grassy Woodlands		Red Gum Woodland (BC Act & EPBC Act)	
White Box Grassy Woodland (Derived Native Grassland)[2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland) [2]	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	55.4
White Box Melaleuca riverine forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	17.0
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	37.1
White Box - White Cypress Pine shrubby open forest; White Box - White Cypress Pine shrubby open forest (Callitris Regrowth); White Box - White Cypress Pine shrubby open forest (Shiny Bush)	PCT1308 / BVT NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	879.9
Yellow Box – Blakely's Red Gum grassy woodland[1]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion[1]	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	12.8
New England Blackbutt Rough-barked Apple shrubby open forest	PCT542 / BVT NA162: Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion	New England Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Not listed	1.3
White Box Dwyer's Red Gum Manna Gum shrubby woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	38.0
Other land (Farm Dams)	Miscellaneous Ecosystems - water	n/a	n/a	Not listed	0.4

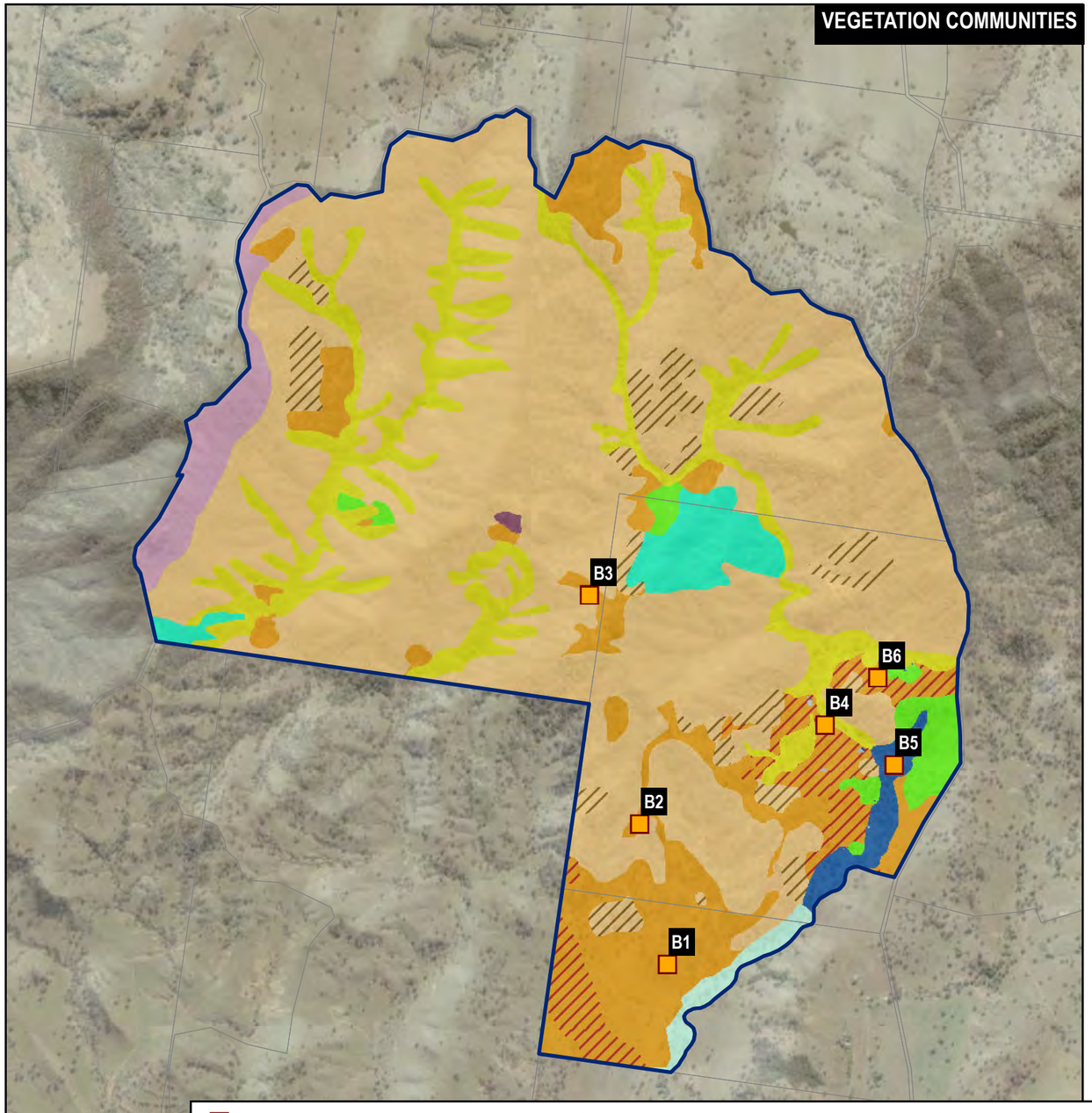
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
	bodies, rivers, lakes, streams (not wetlands)				
Total					**1400.7**

Notes:
1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland BC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
3 Low condition refers to Derived Native Grassland.

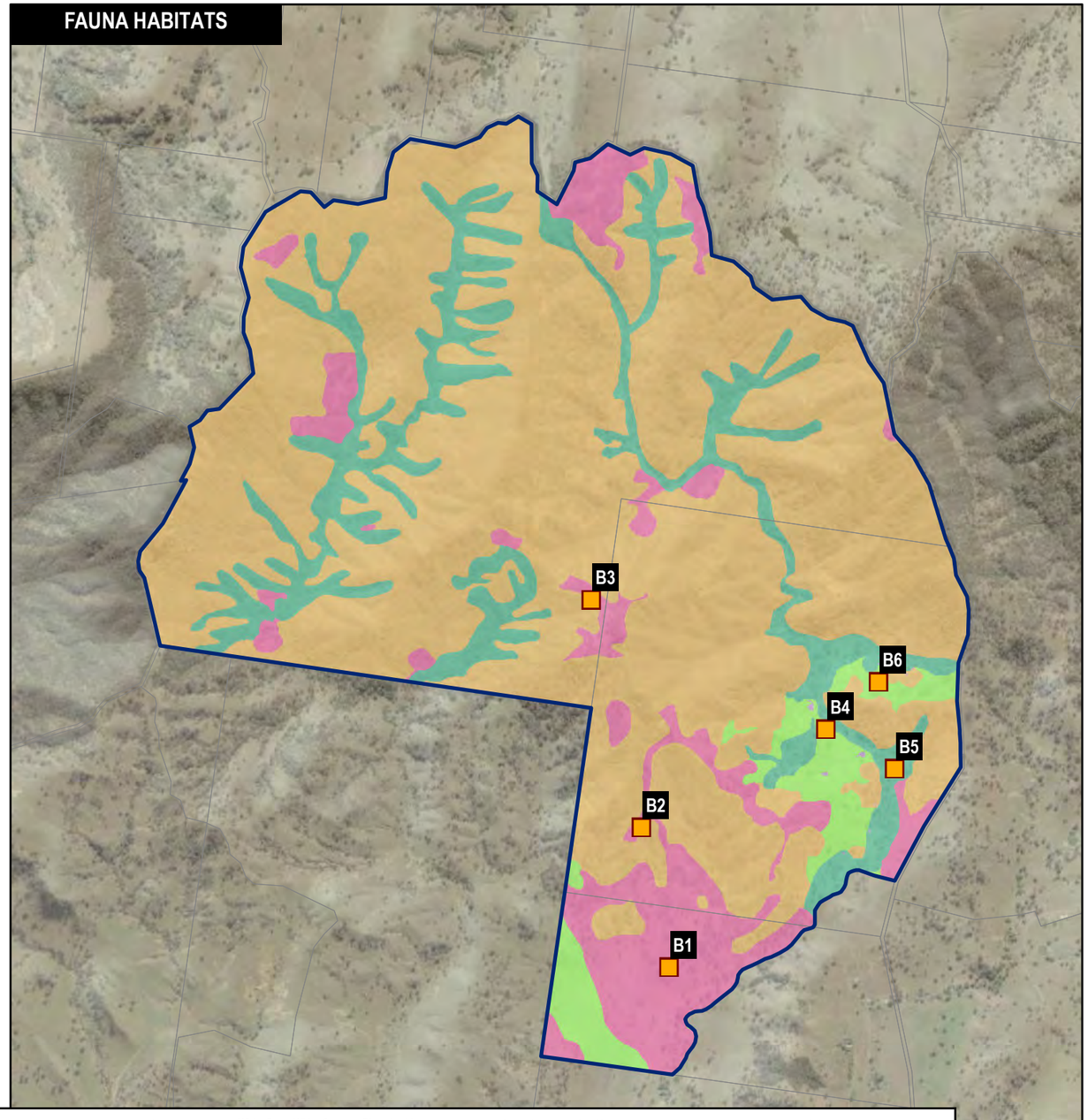
Table E-16 Fauna habitat types within the Braefield BOA

Fauna habitat	Area (ha)
Grassland / Pasture	55.4
Grassy woodland on fertile soils	165.1
Shrubby woodlands/Open forest on skeletal soils	982.7
Riverine woodland	197.1
Farm dams	0.4
Total	**1400.7**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [PCT427/NA410]

Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion

Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion [PCT530/NA309]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions - Derived Grassland [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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Scale 1:30,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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REVIEW	suansrir
DATE.	10/08/2018

APPENDIX **E-8**

TITLE. **VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE BRAEFIELD BOA**

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Table E-17 summarises the threatened species recorded or predicted to occur within the Braefield BOA. Threatened species and ecological communities recorded within the Braefield BOA are illustrated in Figure E-9.

Table E-17 Threatened species recorded or predicted to occur within the Braefield BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Tylophora linearis	E	E	Recorded
Diuris tricolor	-	V	Potential habitat
Dichanthium setosum	V	V	
Digitaria porrecta	E	E	
Pomaderris queenslandica	-	E	
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	E	-	
Picris evae	V	V	
Thesium australe	-	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Diamond Firetail		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Lorikeet		V	
Painted Honeyeater		V	
Rainbow Bee-eater	M		
Turquoise Parrot		V	
Speckled Warbler		V	
Varied Sittella		V	
Black-chinned Honeyeater		V	Potential habitat
Black Falcon		V	
Barking Owl		V	
Fork-tailed Swift	M		
Masked Owl		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Swift Parrot	CE	E1	
Little Eagle		V	

Species	EPBC Act[1]	BC Act[2]	Note
White-throated Needletail	M		
Mammals			
Eastern Cave Bat		V	Potential habitat
Grey-headed Flying-fox	V	V	
Eastern Bent-wing Bat		V	
Yellow-bellied Sheathtail Bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	V	V	
Squirrel Glider		V	
Koala		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act

BRAEFIELD

Legend

- Brown Treecreeper
- Diamond Firetail
- Grey-crowned Babbler
- Hooded Robin
- Little Lorikeet
- Speckled Warbler
- Turquoise Parrot
- Varied Sittella
- Offset boundary
- Box Gum Woodland (State 1: Woodland) - EPBC Act
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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Imagery:
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AUTHOR. SuansriR

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DATE. 7/09/2018

APPENDIX E-9

TITLE. IMPLEMENTATION MEASURES FOR THE BRAEFIELD BOA

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Baseline habitat conditions for matters of National Environmental Significance

The Braefield BOA contains approximately 194.3 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which has been classified as State 1 Box Gum woodland in accordance with the methodology outline in Section 6.2.1 of the main BMP document. A further 55.4 ha of derived grassland meets the BC Act criteria for listing under the BC Act and is also classified as State 2 Derived Native Pastures. This ecological community is situated the throughout the Braefield BOA on lower slopes and flatter land (Figure E-9).

The Braefield BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying Fox, Corben's Long-eared Bat and Large-eared Pied Bat.

E1.1.3.2 Planning

Completion criteria

The completion criteria for management of the Braefield BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Braefield BOA contains three offset management zones, as detailed in Table E-18 and illustrated in Figure E-10.

Table E-18 Offset management zones within the Braefield BOA

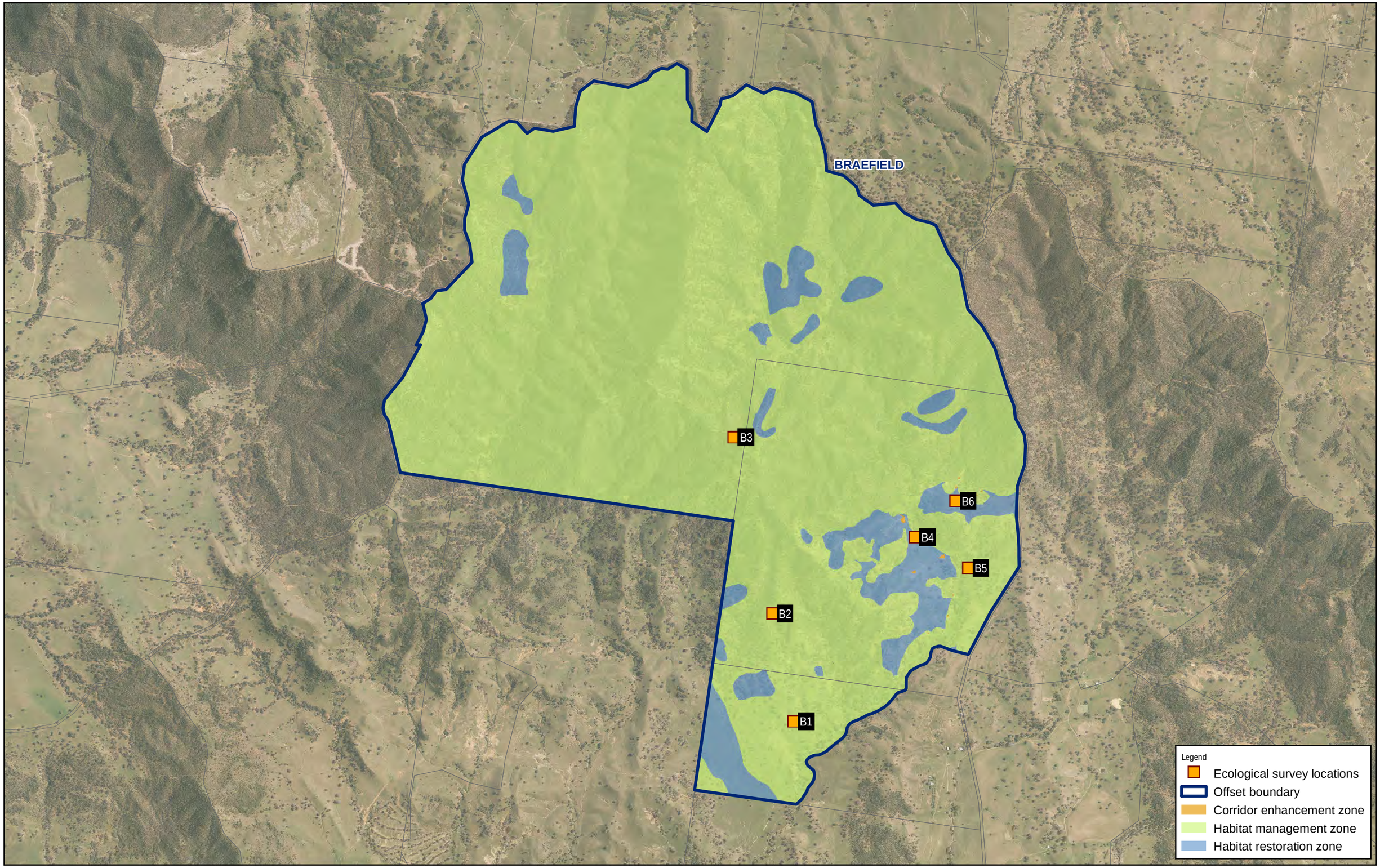
Offset management zone	Area (ha)
Habitat management zone	1,283.2
Habitat restoration zone	117.1
Corridor enhancement zone	0.4
Total	**1,400.7**

Threats and disturbances

Existing threats and disturbances within the Braefield BOA include:

- Clearing and fragmentation — a small portion of the southern section of the Braefield BOA has been historically cleared and now occurs as low condition woodland and derived native grassland (Figure E-8).
- Livestock grazing — the Braefield BOA is currently being grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the property, thereby promoting weed growth.
- Weedy exotic plants and pest animals — the Braefield BOA contains areas of low weed density, particularly within the cleared grassland areas, where grazing is occurring (Figure E-36). Without management intervention, weed densities within this area may increase and potentially spread into low density weed areas throughout the BOA. Pest animals were observed throughout the property including Goats, rabbits, pigs and foxes.
- Invasion of native shrub species (i.e. *Dodonea viscosa*, *Beyeria viscosa*, *Oleria elliptica*). Dense thickets of these three species occur on the cleared hill tops and upper slopes in the north of the BOA (Figure E-36). A specific management intervention will be required to prevent further spread of these shrubs throughout the BOA.

- Invasion of native pine species (*Callitris glauclophylla*). This species occurs in dense thickets on the hillsides in the south east and north east of the property (Figure E-36). The previous owner has been undertaking.
- Alteration of abiotic factors (hydrology, nutrients and soil) - The Braefield BOA contains several large ephemeral drainage lines. The drainage line in the south east of the BOA contains some small areas of erosion. Currently management techniques are being employed to mitigate this erosion and further management sediment and erosion works will be required to mitigate any further erosion.
- Pesticides and herbicides – area if remnant native vegetation within the BOA may be subjected to spray drift or chemical run-off from adjoining agricultural land to the north and south west.



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Imagery:
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APPENDIX E-10

TITLE. IMPLEMENTATION MEASURES FOR THE BRAEFIELD BOA

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E1.2 Central Offsets

E1.2.1 Mallee BOA

The Mallee BOA encompasses an area of 2,066.2 ha and is located approximately 8.4 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Mallee BOA is provided in Table E-19 and the site locality is illustrated in Figure E-1.

Table E-19 Summary of Mallee BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment
Botanical subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Keepit Slopes and Plains, Split Yard Plateau Bugaldie Uplands
Noxious weed control area	Narrabri

E1.2.1.1 Baseline condition

The Mallee BOA lies within the Nandewar Range and forms the north-east corner of the Regional East-West Wildlife Corridor. The BOA supports woodland habitats of good quality with very few edge effects. The vegetation and fauna habitat types present are illustrated in Figure E-11 and a breakdown is provided in Table E-20 and Table E-21.

Table E-20 Vegetation types within the Mallee BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
Dwyer's Red Gum Woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	91.4
Myrtle Shrubland (+- White Pine/Tumbledown Red Gum); Dripping Rock	PCT427 / BVT NA4105: Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion	Inland Rocky Hill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	Not listed	142.9
River Oak Riparian Open Forest	PCT84 / BVT NA4191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	2.1
Rough-barked Apple Riparian Forb/Grass Open Forest	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	16.8
White Box – Narrow-leaved Ironbark - White Cypress Pine	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the	Northern Tableland Dry	Dry Sclerophyll Forests (Shrubby	Not listed	30.9

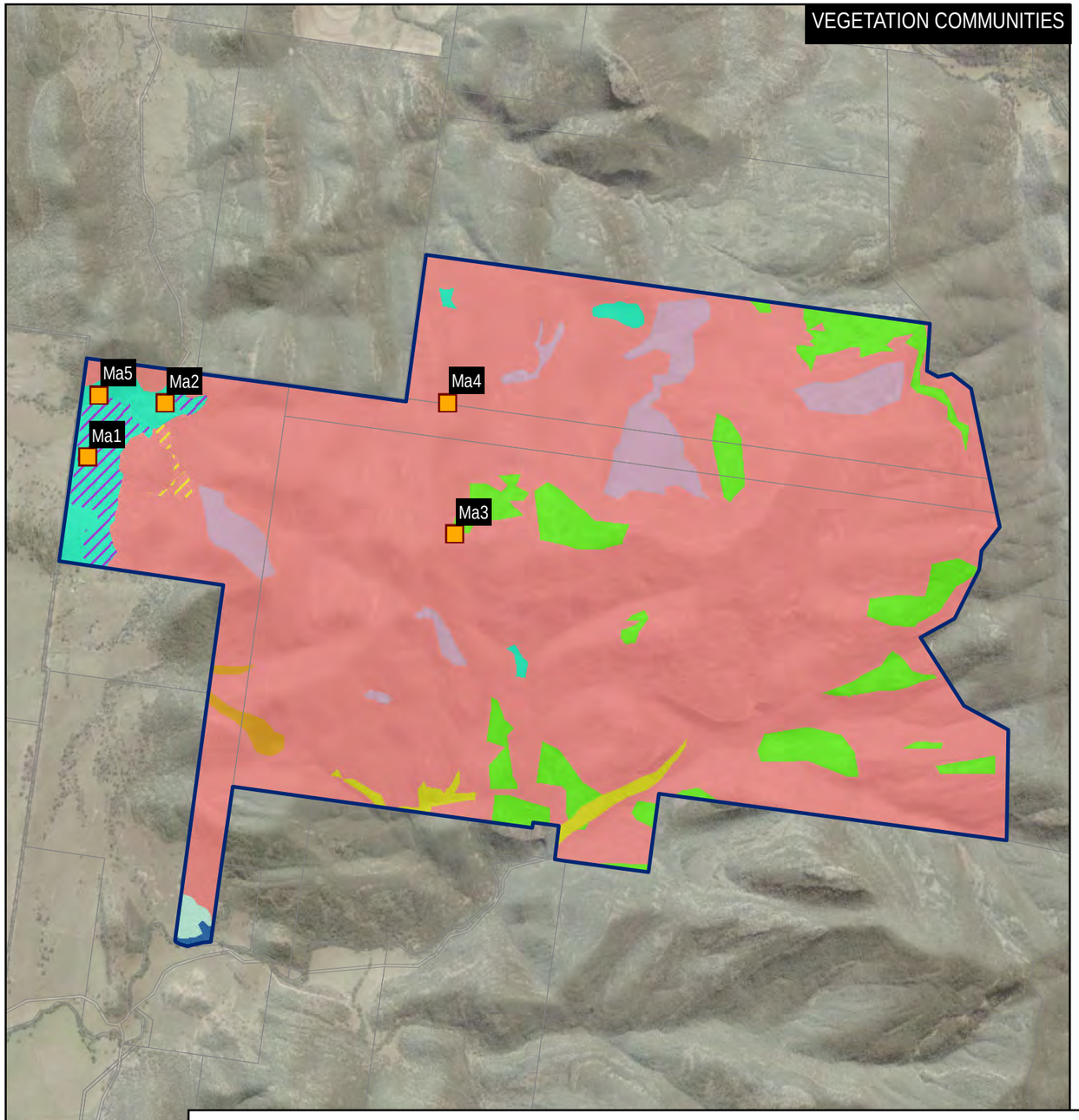
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
shrubby open forest	Brigalow Belt South bioregion	Sclerophyll Forests	sub-formation)		
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low Condition)	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	36.3
White Box – White Cypress Pine grassy woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act) [1]	9.2
Yellow Box - Blakely's Red Gum grassy woodland[1]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion []	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act) [1]	5.0
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	1,727.6
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest (Low Condition)	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	4.0
Total					**2,066.2**

Notes: 1 = Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Low condition = Derived Native Grassland.

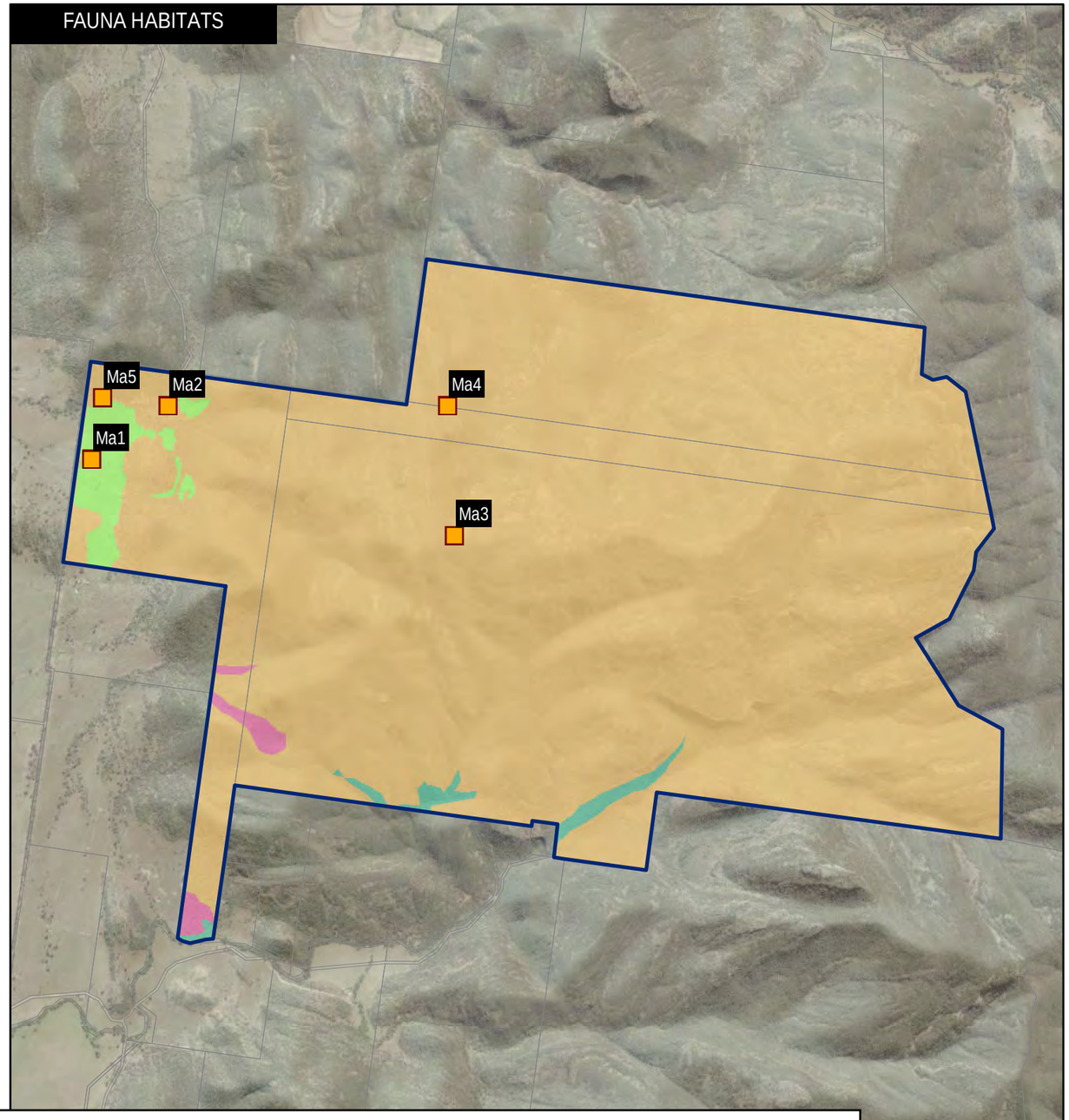
Table E-21 Fauna habitat types within the Mallee BOA

Fauna habitat	Area (ha)
Grassland	40.3
Grassy woodland on fertile soils	14.2
Shrubby woodlands/Open forest on skeletal soils	1,992.8
Riverine woodland	18.9
Total	**2,066.2**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [PCT427/NA410]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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Scale 1:37,500

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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REVIEW	suansrir
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APPENDIX E-11

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE MALLEE BOA

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Table E-22 summarises the threatened species recorded or predicted to occur within the Mallee BOA. Threatened species and ecological communities recorded within the Mallee BOA are illustrated in Figure E-12.

Table E-22 Threatened species recorded or predicted to occur within the Mallee BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria Porrecta	E	E1	Potential habitat
Pomaderris queenslandica		E1	
Diuris tricolor	V	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Diamond Firetail		V	
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Eagle		V	
Little Lorikeet		V	
Rainbow Bee-eater	M		
Satin Flycatcher	M		
Speckled Warbler		V	
Turquoise Parrot		V	
Varied Sittella		V	
Barking Owl		V	Potential habitat
Black-chinned Honeyeater		V	
Masked Owl		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Mammals			
Eastern Cave Bat		V	Recorded
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Squirrel Glider		V	

Species	EPBC Act[1]	BC Act[2]	Note
Yellow-bellied Sheathtail Bat		V	
Brush-tailed Rock Wallaby	V	E	Potential habitat
Corbens Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Koala		V	
Spotted-tailed Quoll	E	V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act

Baseline habitat conditions for matters of National Environmental Significance

The Mallee BOA contains approximately 14.2 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. All of the vegetation within the Mallee Property has been classified as State 1 Woodland in accordance with the methodology outline in Section 6.2.1. This ecological community is situated in the western portion of the Mallee BOA and is contiguous with the Wirrilah BOA (Figure E-12).

The Mallee BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox, Corben's Long-eared Bat and Large-eared Pied Bat.

MALLEE

MALLEE LANE

DRIPPING ROCK ROAD

Legend

- Brown Treecreeper
- Diamond Firetail
- Dusky Woodswallow
- Eastern Bent-wing Bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Grey-crowned Babbler
- Hooded Robin
- Little Eagle
- Little Lorikeet
- Satin Flycatcher
- Speckled Warbler
- Squirrel Glider
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheathtail-bat
- Offset boundary
- Box Gum Woodland (State 1: Woodland) - EPBC Act

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Scale 1:25,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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MINE NAME. 2171706A_GIS_BMP007_A2

AUTHOR. SuansriR

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DATE. 7/09/2018

APPENDIX E-12

TITLE. IMPLEMENTATION MEASURES FOR THE MALLEE BOA

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E1.2.1.2 Planning

Completion criteria

The completion criteria for management of the Mallee BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Mallee BOA contains two offset management zones, as detailed in Table E-23 and illustrated in Figure E-13.

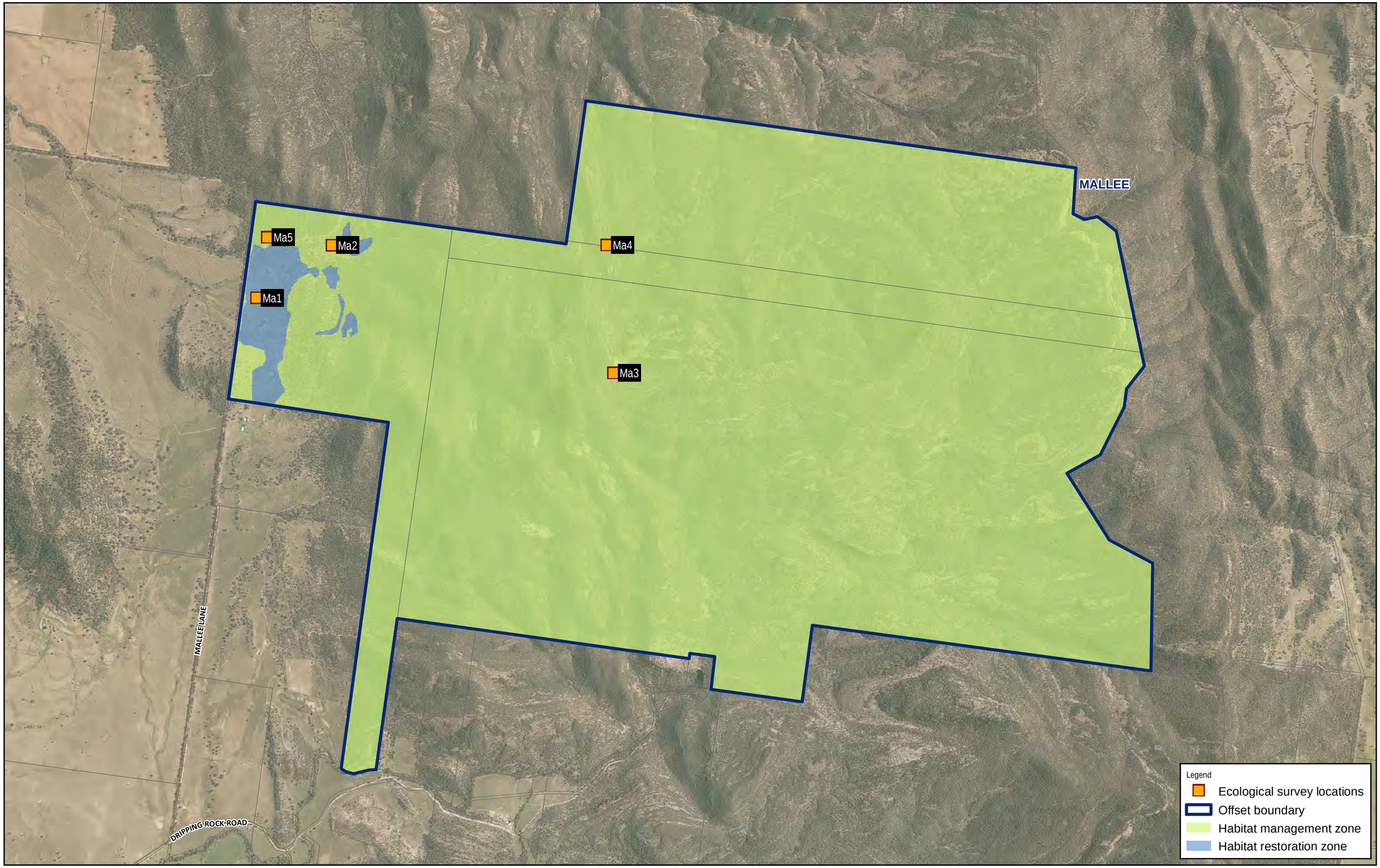
Table E-23 Offset management zones within the Mallee BOA

Offset management zone	Area (ha)
Habitat management zone	2,025.9
Habitat restoration zone	40.3
Total	**2,066.2**

Threats and disturbances

The Mallee BOA is relatively undisturbed as much of the site adjoins well-connected bushland, with topography historically constraining human access and agricultural land uses. Existing threats and disturbances within the Mallee BOA include:

- Weedy exotic plants and pest animals — the majority of land within the Mallee BOA contains low densities of weed species. The western extent of the property, which adjoins the Myall Plains and Wirrilah BOA, has been classified as containing moderate weed densities (Figure E-38). Without management intervention, the abundance of weeds within this area may increase and potentially spread into areas currently supporting low weed densities throughout the BOA.
- Pesticides and herbicides – land adjoining the western BOA boundary may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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Imagery:
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DATE.	6/09/2018

APPENDIX E-13

TITLE. IMPLEMENTATION MEASURES FOR THE MALLEE BOA

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E1.2.2 Myall Plains BOA

The Myall Plains BOA encompasses an area of 473.3 ha and is located approximately 8 km north-west of the EIS mine disturbance limit (Boggabri Existing). The southern boundary of the Myall Plains BOA adjoins the Mallee and Merriendi BOAs. A summary of the Myall Plains BOA is provided in Table E-24 and the site locality is illustrated in Figure E-1.

Table E-24 Summary of Myall Plains BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Keepit Slopes and Plains Liverpool Alluvial Plains
Noxious weed control area	Narrabri

E1.2.2.1 Baseline condition

The Myall Plains BOA lies within the Nandewar Range and forms the north-east corner of the Regional East-West Wildlife Corridor. The BOAsupports woodland habitats in relatively good condition. The vegetation and fauna habitat types present are illustrated in Figure E-14 and a breakdown is provided in Table E-25 and Table E-26.

Table E-25 Vegetation types within the Myall Plains BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	6.1
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	96.2
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low condition)	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion (Derived Native Grassland)	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	42.5
White Box – White Cypress Pine grassy woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White Box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	66.5

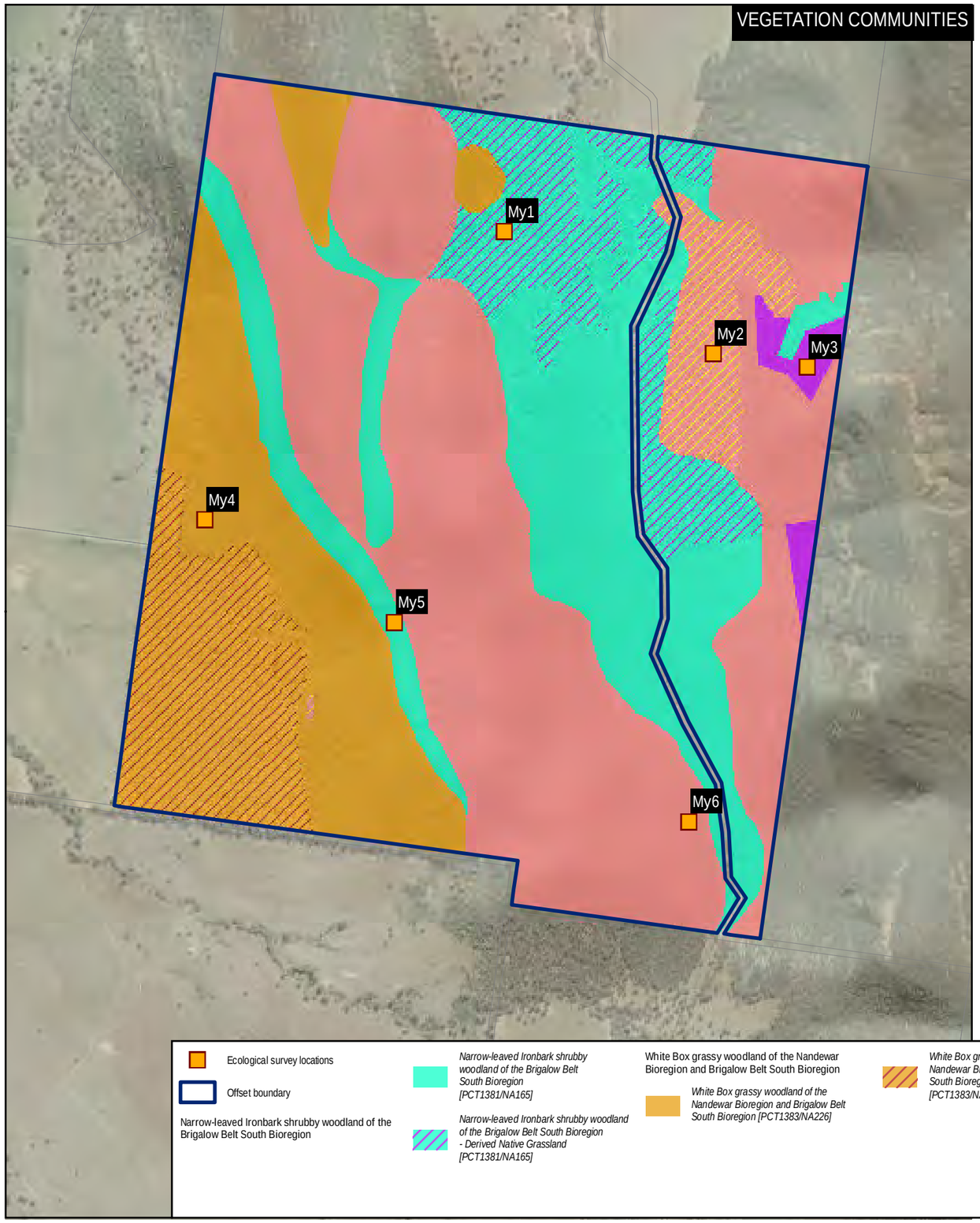
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
White Box – White Cypress Pine grassy woodland (Low Condition)[2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White Box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	43.9
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	198.6
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest (Low Condition)	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	19.5
Total					**473.3.**

Notes:
1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland BC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Table E-26 Fauna habitat types within the Myall Plains BOA

Fauna habitat	Area (ha)
Grassland / Pasture	62.0
Grassy woodland on fertile soils	66.5
Shrubby woodlands/Open forest on skeletal soils	300.9
Other land (intensive agriculture and farm dams)	43.9
Total	**473.3**

VEGETATION COMMUNITIES



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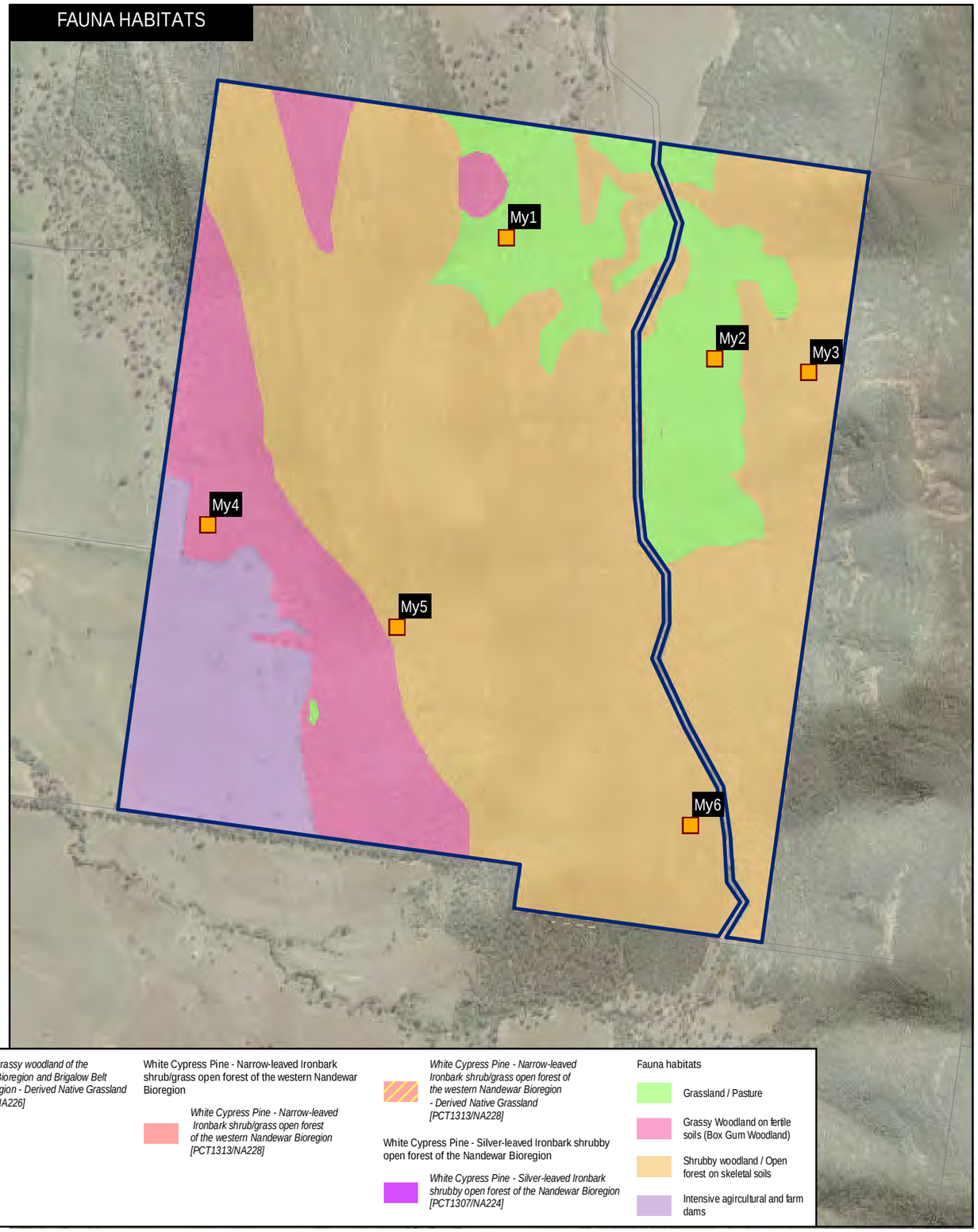

Ecological survey locations

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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APPENDIX E-14

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE MYALL PLAINS BOA

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Table E-27 summarises the threatened species recorded or predicted to occur within the Myall Plains BOA. Threatened species and ecological communities recorded within the Myall Plains BOA are illustrated in Figure E-15.

Table E-27 Threatened species recorded or predicted to occur within the Myall Plains BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria Porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Eagle		V	
Little Lorikeet		V	
Speckled Warbler		V	
Turquoise Parrot		V	
Varied Sittella		V	
Barking Owl		V	
Black-chinned Honeyeater		V	Potential habitat
Diamond Firetail		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Masked Owl		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Mammals			
Eastern Bent-wing Bat		V	Recorded
Eastern Cave Bat		V	
Eastern False Pipistrelle		V	
Koala		V	
Squirrel Glider		V	
Yellow-bellied Sheathtail Bat		V	

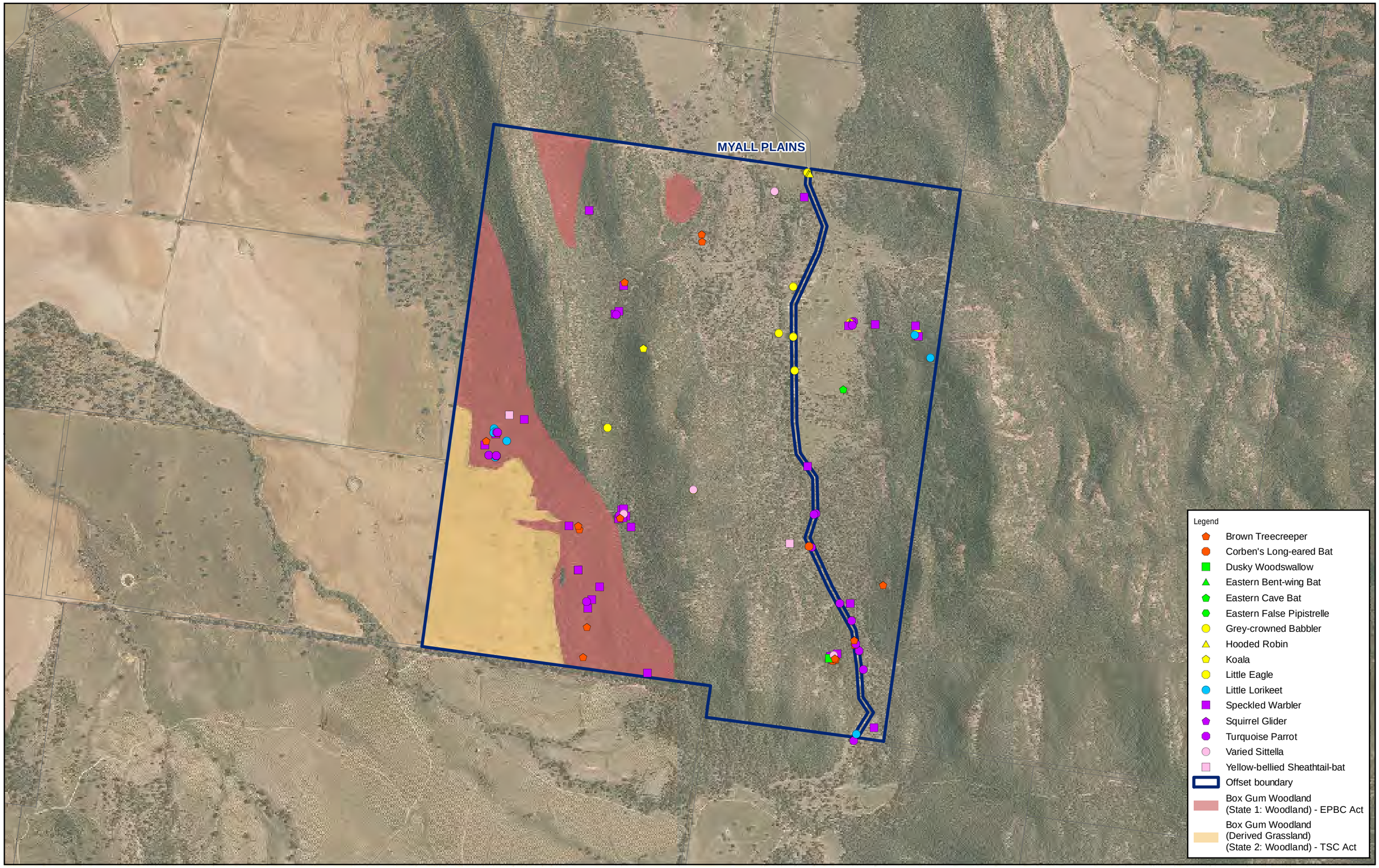
Species	EPBC Act[1]	BC Act[2]	Note
Corben's Long-eared Bat	V	V	
Little Pied Bat		V	Potential habitat
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	E	V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	Potential habitat

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act

Baseline habitat conditions for matters of National Environmental Significance

The Myall Plains BOA contains approximately 66.5 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland as per the methodology set out in Section 6.2.1 of main BMP document. A further 43.9 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the BC Act listing for this community. This ecological community is situated in the western and central portions of the Myall Plains BOA on lower slopes and flatter land (Figure E-15).

Corben's Long-eared Bat, which is listed as Vulnerable under the EPBC Act, has been recorded in the Myall Plaina BOA. In addition, the Myall Plains BOA provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox and Large-eared Pied Bat.



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APPENDIX E-15

TITLE. IMPLEMENTATION MEASURES FOR THE MYALL PLAINS BOA

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E1.2.2.2 Planning

Completion criteria

The completion criteria for management of the Myall Plains BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Myall Plains BOA contains three offset management zones, as detailed in Table E-28 and illustrated in Figure E-16.

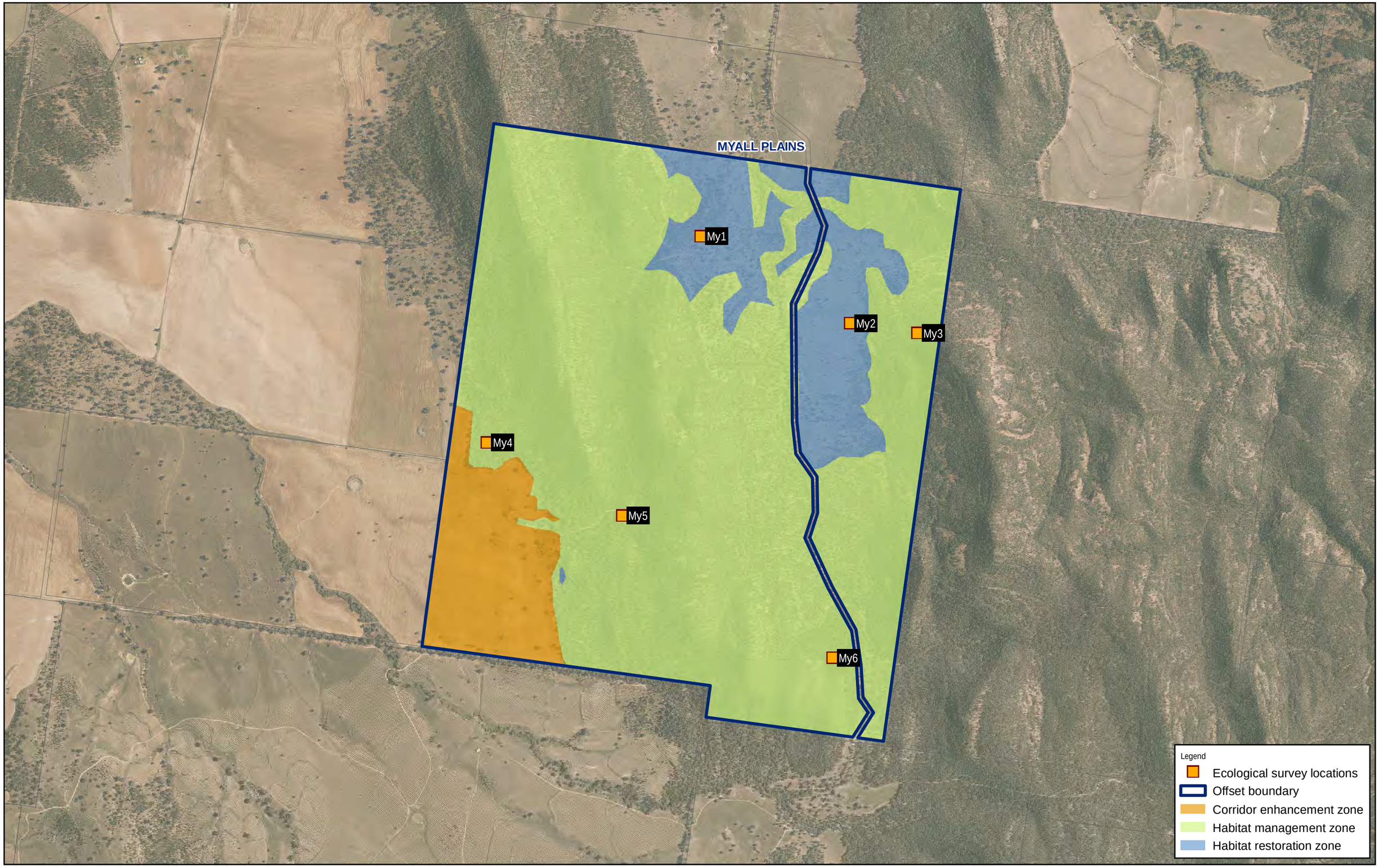
Table E-28 Offset management zones within the Myall Plains BOA

Offset management zone	Area (ha)
Habitat management zone	367.4
Habitat restoration zone	62.0
Corridor enhancement zone	43.9
Total	**473.3**

Threats and disturbances

Existing threats and disturbances within the Myall Plains BOA include:

- Clearing and fragmentation — a large proportion of the Myall Plains BOA supports remnant woodland; however areas which have been historically cleared and now occur as low condition woodland, derived native grassland, exotic dominated pasture or agricultural crops (Figure E-14).
- Livestock grazing — the Myall Plains BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the BOA, thereby promoting weed growth.
- Weedy exotic plants and pest animals — the habitat management zone, which constitutes a large proportion of the Myall Plains BOA, contains a low density of weeds and pests. The areas classified as Habitat Restoration Zone within the north-east property area contains moderate weed densities (Figure E-39). Without management intervention, weed densities within this area may increase and potentially spread into low density weed areas throughout the BOA. During recent site inspections, a number of feral goats were observed within the Myall Plains BOA. These feral pests are known to damage soil, prohibit native species regeneration and compete for food resources with native species.
- Alteration of abiotic factors (hydrology, nutrients and soil) — The Myall Plains BOA contains several large ephemeral drainage lines. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities.
- Pesticides and herbicides — land within the southern corner of the Myall Plains BOA may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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APPENDIX E-16

TITLE. IMPLEMENTATION MEASURES FOR THE MYALL PLAINS BOA

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E1.2.3 Wirrilah BOA

The Wirrilah BOA encompasses an area of 884.2 ha and is located approximately 3.9 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Wirrilah BOA is provided in Table E-29 and the site locality is illustrated in Figure E-1.

Table E-29 Summary of Wirrilah BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Bugaldie Uplands Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Narrabri

E1.2.3.1 Baseline condition

The Wirrilah BOA lies within the Nandewar Range and forms the north-east corner of the Regional East-West Wildlife Corridor. Much of the woodland within the Wirrilah BOA is in relatively good condition. Regeneration is present on many parts of the main ridge, particularly on the lower slopes. The vegetation and fauna habitat types present are illustrated in Figure E-17 and a breakdown is provided in Table E-30 and Table E-31.

Table E-30 Vegetation types within the Wirrilah BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest and Regrowth White Cypress Pine	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	106.4
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low condition)	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion (Derived Native Grassland)	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	24.7
White Box – White Cypress Pine grassy woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	146.1

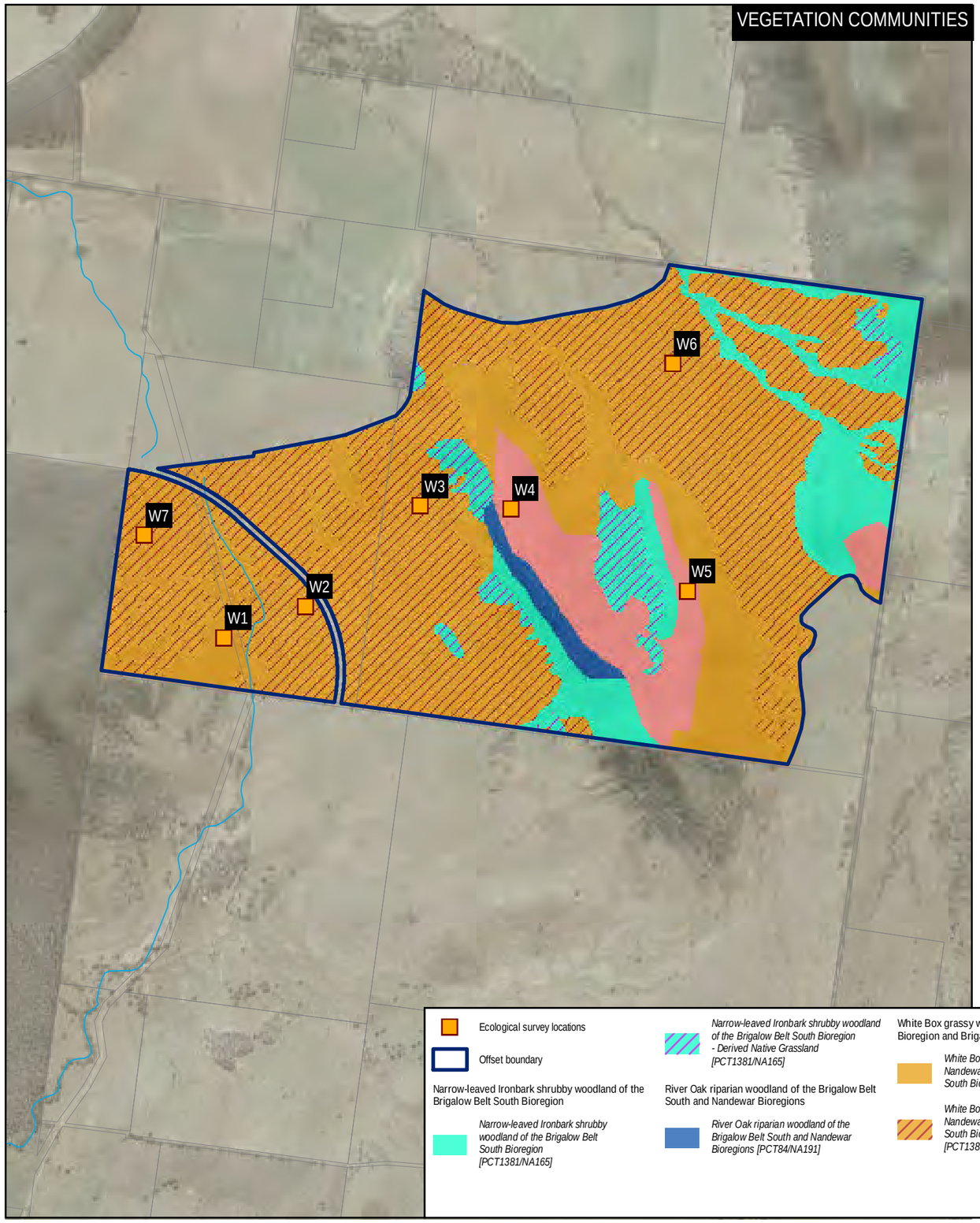
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
White Box – White Cypress Pine grassy woodland (Low Condition) [2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	517.5
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Grassy Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	76.9
Emergent Rough-barked Apple low closed forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	12.6
Total					**884.2**

Notes:
1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, 2 = Commensurate with State 2 Derived Native Grassland BC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
2 Low condition refers to Derived Native Grassland and regrowth Callitris.

Table E-31 Fauna habitat types within the Wirrilah BOA

Fauna habitat	Area (ha)
Grassland	356.6
Grassy woodland on fertile soils	146.1
Shrubby woodlands/Open forest on skeletal soils	183.3
Riverine Woodland	12.6
Other land (intensive agriculture and farm dams)	185.6
Total	**884.2**

VEGETATION COMMUNITIES



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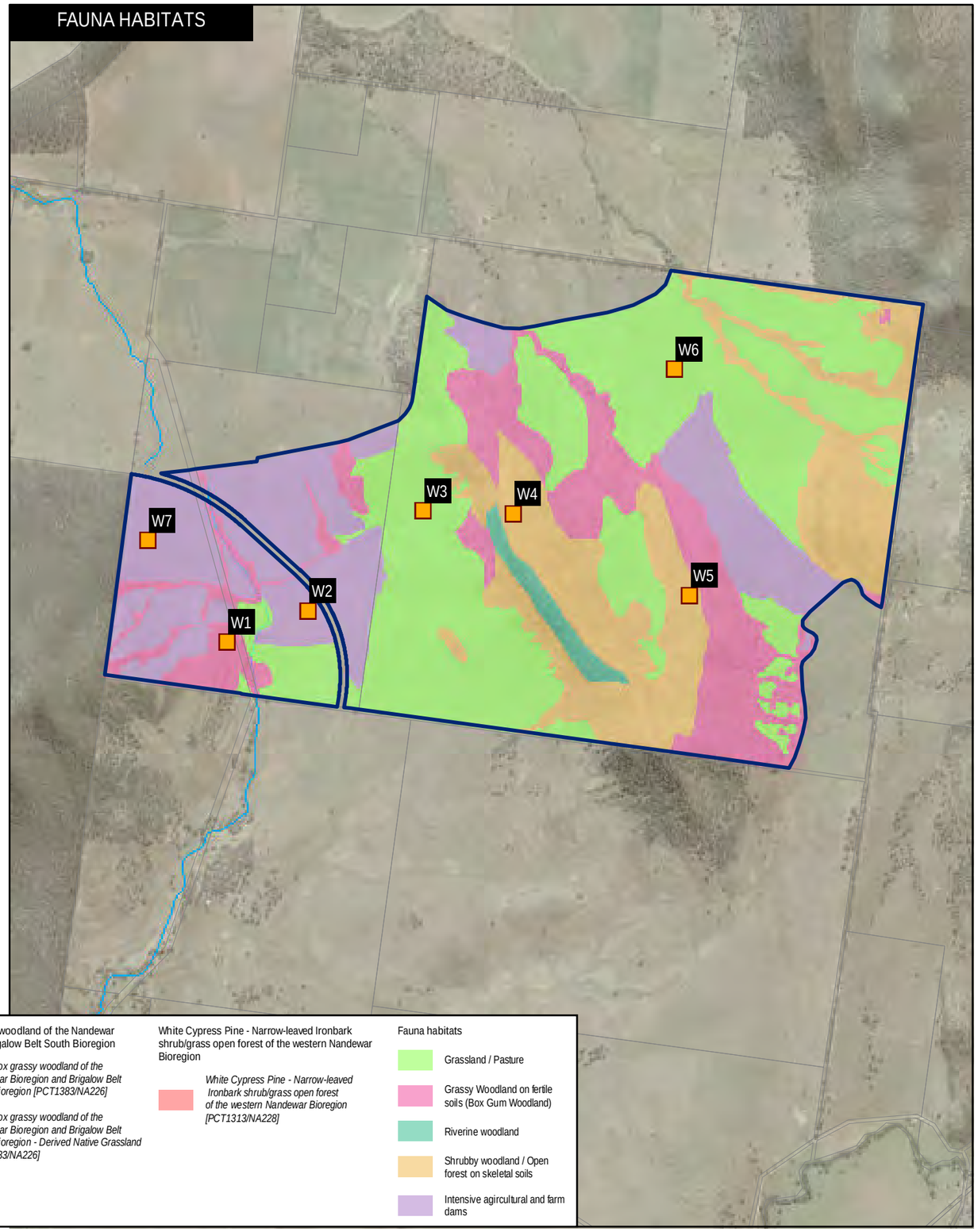

Ecological survey locations

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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APPENDIX E-17

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE WIRRILAH BOA

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Table E-32 summarises the threatened species recorded or predicted to occur within the Wirrilah BOA. Threatened species and ecological communities recorded within the Wirrilah BOA are illustrated in Figure E-18.

Table E-32 Threatened species recorded or predicted to occur within the Wirrilah BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Barking Owl		V	Recorded
Brown Treecreeper		V	
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Little Eagle		V	
Little Lorikeet		V	
Painted Honeyeater		V	
Speckled Warbler		V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Black-chinned Honeyeater		V	Potential habitat
Diamond Fire-tail		V	
Hooded Robin		V	
Masked Owl		V	
Regent Honeyeater	CE	CE	
Pied Honeyeater		V	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Mammals			
Eastern Cave Bat		V	Recorded
Squirrel Glider		V	
Yellow-bellied Sheathtail Bat		V	
Eastern Bent-wing Bat		V	Potential habitat
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Koala		V	

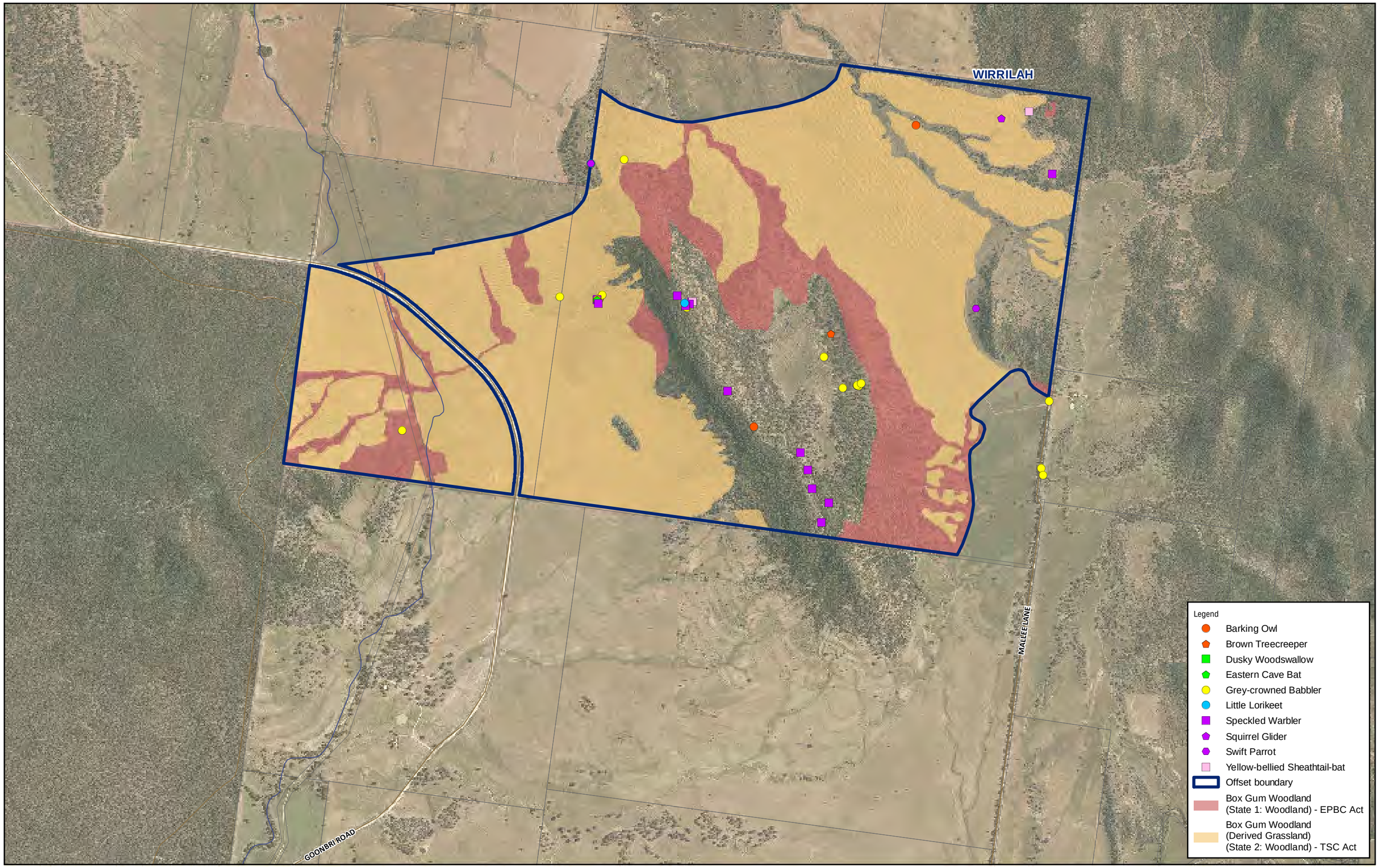
Species	EPBC Act[1]	BC Act[2]	Note
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act

Baseline habitat conditions for matters of National Environmental Significance

The Wirrilah BOA contains approximately 145.1 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland as per the methodology set out in Section 6.2.1 of main BMP document. A further 517.5 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the BC Act listing for this community. This ecological community is situated the throughout the Wirrilah BOA on lower slopes and flatter land (Figure E-18).

The Swift Parrot, which is listed as Critically Endangered under the EPBC Act, has been recorded in the Wirrilah BOA. In addition, the Wirrilah BOA also provides suitable habitat for the Regent Honeyeater, Superb Parrot, Grey-headed Flying-fox, Corben's Long-eared Bat and Large-eared Pied Bat.



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APPENDIX E-18

TITLE. IMPLEMENTATION MEASURES FOR THE WIRRILAH BOA

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E1.2.3.2 Planning

Completion criteria

The completion criteria for management of the Wirrilah BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Wirrilah BOAcontains three offset management zones, as detailed in Table E-33 and illustrated in Figure E-19.

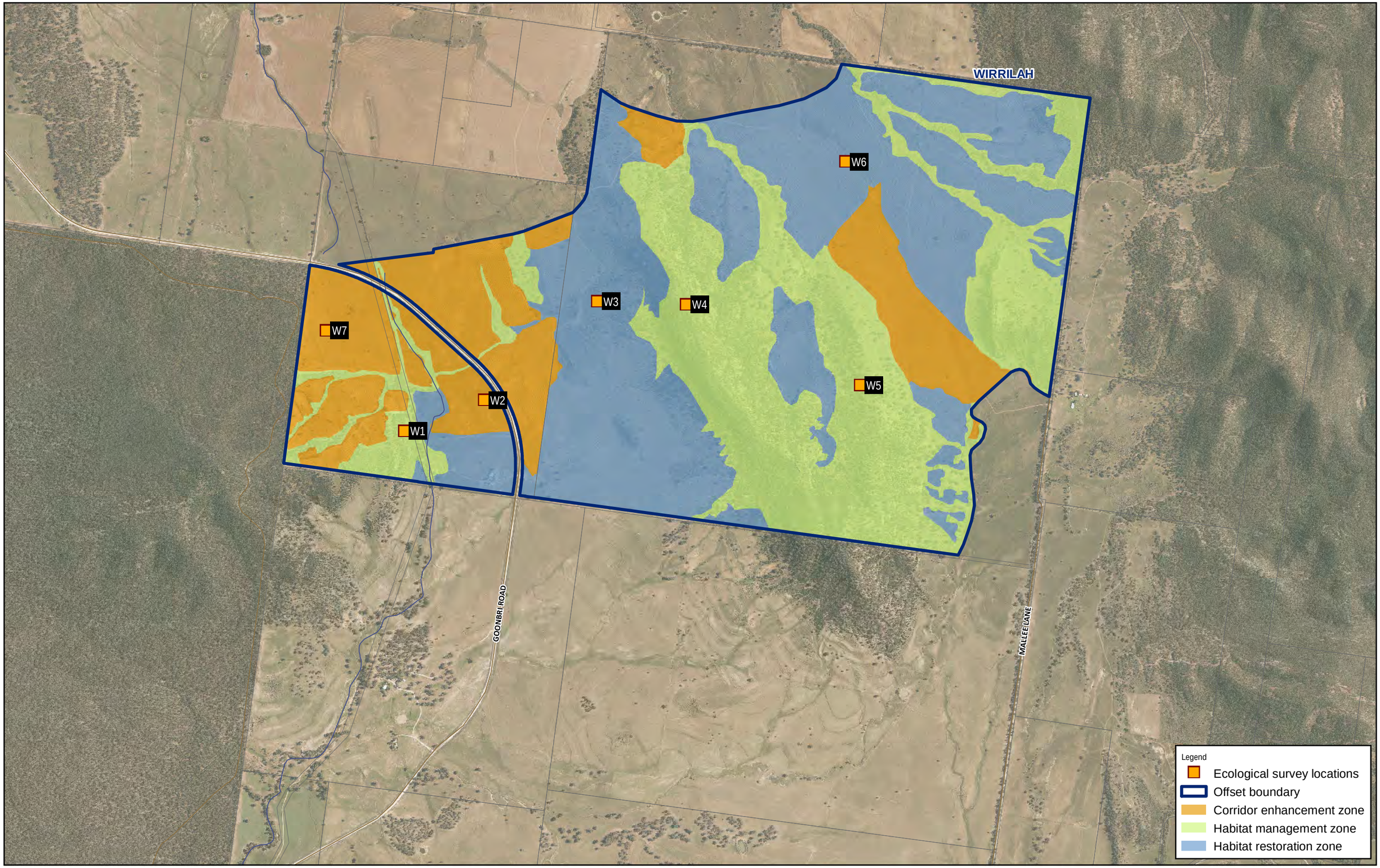
Table E-33 Offset management zones within the Wirrilah BOA

Offset management zone	Area (ha)
Habitat management zone	326.8
Habitat restoration zone	371.8
Corridor enhancement zone	185.6
Total	**884.2**

Threats and disturbances

Existing threats and disturbances within the Wirrilah BOA include:

- Clearing and fragmentation — a large proportion of the Wirrilah BOA has been historically cleared now occurs as low condition woodland, derived native grassland or exotic dominated pasture (Figure E-17).
- Livestock grazing — the Wirrilah BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the BOA, thereby promoting weed growth.
- Weedy exotic plants and pest animals – the Wirrilah BOA contains areas of high weed density, particularly within the western area of the BOA, where grazing is intensified (Figure E-40). Without management intervention, weed densities within this area may increase and potentially spread into low density weed areas throughout the BOA.
- Alteration of abiotic factors (hydrology, nutrients and soil) — The Wirrilah BOA contains several large ephemeral drainage lines. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities.
- Pesticides and herbicides — area if remnant native vegetation within the BOA may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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APPENDIX E-19

TITLE. IMPLEMENTATION MEASURES FOR THE WIRRILAH BOA

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E1.2.4 Goonbri BOA

The Goonbri BOA encompasses an area of 231.0 ha and is located approximately 3.9 km north-west of the EIS mine disturbance limit (Boggabri Existing). The Goonbri BOA occurs to the south of the Wirrilah BOA boundary. A summary of the Goonbri BOA is provided in Table E-34 and the site locality is illustrated in Figure E-20.

Table E-34 Summary of Goonbri BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Bugaldie Uplands Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Narrabri

E1.2.4.1 Baseline condition

The Goonbri BOA represents part of the western edge of the Nandewar Range occurring as two separate sections of the Wirrilah property, with which it shares its northern boundary. It functions to bolster the north-east corner of the Regional East-West Wildlife Corridor. Much of the woodland within the Goonbri BOA is in relatively good condition although there are sections of the eastern portion that are dominated by White Cypress Pine (*Callitris glaucophylla*) and the western section shows evidences of a history of grazing pressures. In the west a number of vegetation types occur in an open woodland structure providing habitat for woodland bird species. The vegetation and fauna habitat types present are illustrated in Figure E-20 and a breakdown is provided in Table E-35 and Table E-36.

Table E-35 Vegetation types within the Goonbri BOA

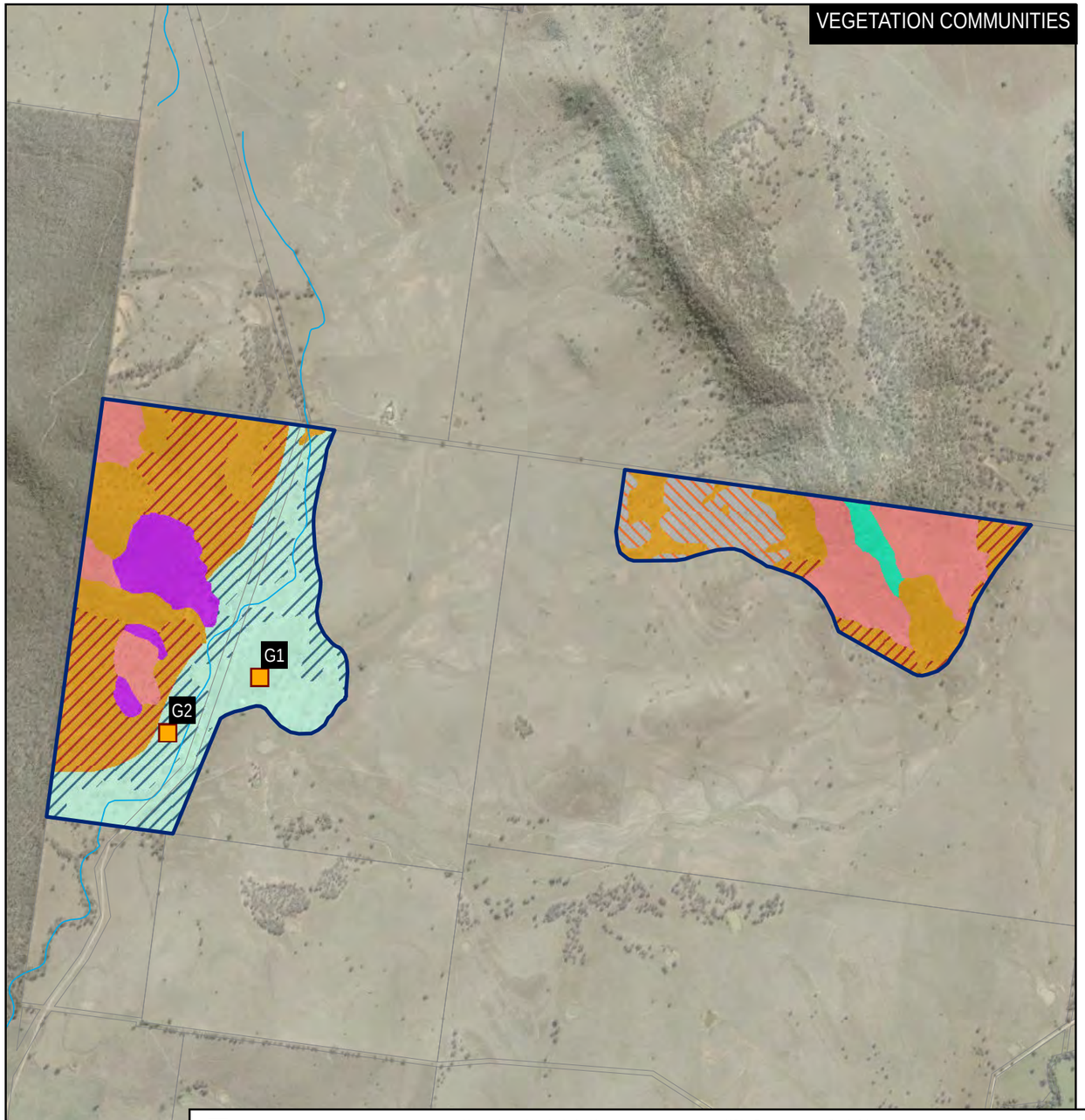
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
White Box – White Cypress Pine grassy woodland	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	38.9
White Box – White Cypress Pine grassy woodland (Low Condition)	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands		51.6
Yellow Box - Blakely's Red	PCT1329 / BVT NA237: Yellow Box -	Western Slopes	Grassy Woodlands		33.4

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
Gum grassy woodland	Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Grassy Woodlands			
Yellow Box - Blakely's Red Gum grassy woodland (Low Condition)	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands		36.7
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	14.5
Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	PCT1313 / BVT NA228: White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	37.2
White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	3.6
Exotic grassland	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	15.1
Total					**231.0**

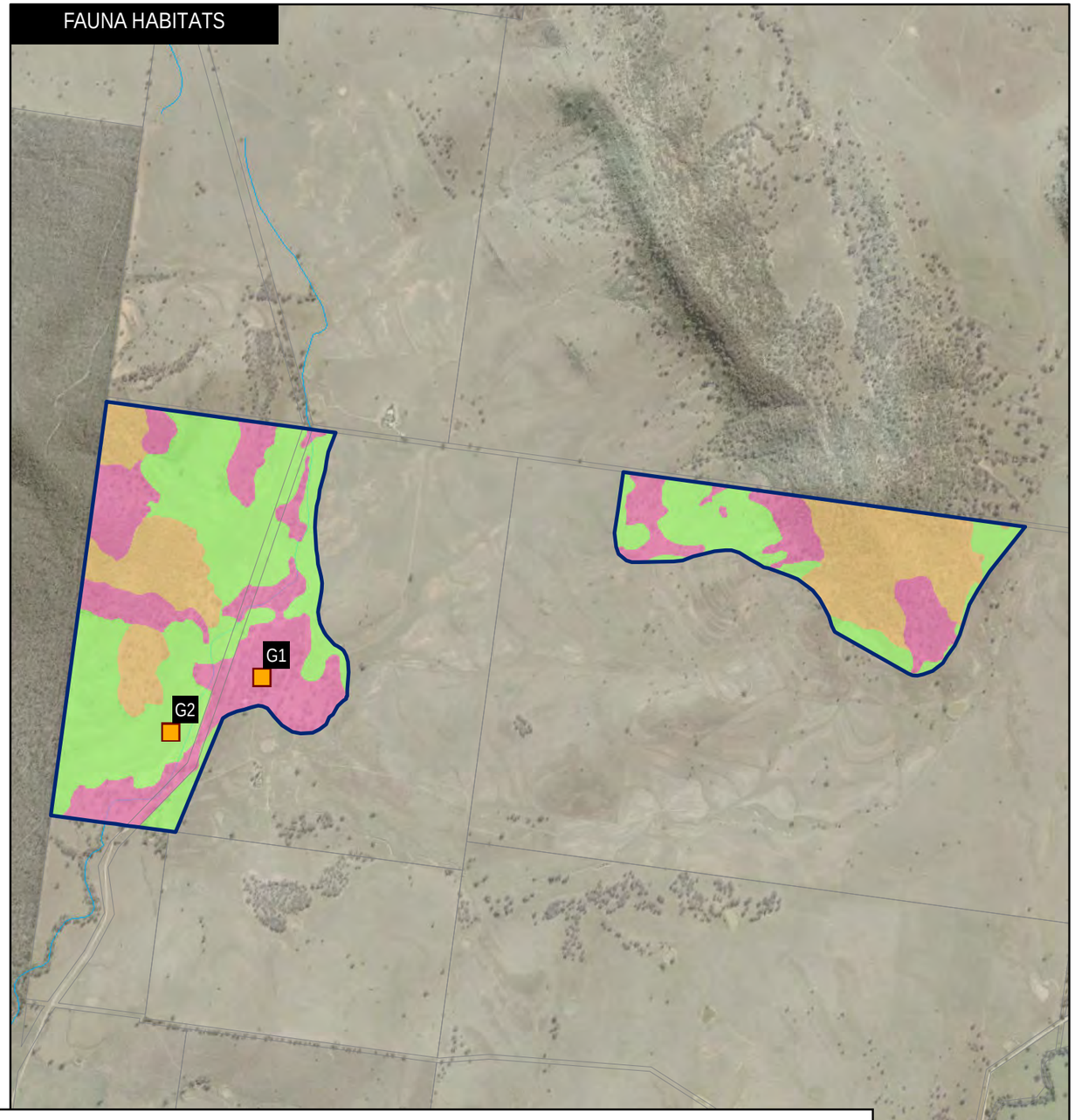
Table E-36 Fauna habitat types within the Goonbri BOA

Fauna habitat	Area (ha)
Grassland	88.3
Grassy woodland on fertile soils	72.3
Shrubby woodlands/Open forest on skeletal soils	55.3
Other land (intensive agriculture)	15.1
Total	**231.0**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion - Derived Native Grassland [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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Imagery:
BCPL (2015) and Copyright:© 2014 Esri

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REVIEW	suansrir
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APPENDIX **E-20**

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE GOONBRI BOA

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Table E-37 summarises the threatened species recorded or predicted to occur within the Goonbri BOA. Threatened species and ecological communities recorded within the Goonbri BOA are illustrated in Table E-21.

Table E-37 Threatened species recorded or predicted to occur within the Goonbri BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Diamond Fire-tail		V	
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Lorikeet		V	
Rainbow Bee-eater	M		
Speckled Warbler		V	
Barking Owl		V	Potential habitat
Little Eagle		V	
Painted Honeyeater		V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Black-chinned Honeyeater		V	
Masked Owl		V	
Regent Honeyeater	CE	CE	
Pied Honeyeater		V	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Mammals			
Eastern Cave Bat		V	Potential habitat
Squirrel Glider		V	
Yellow-bellied Sheathtail Bat		V	
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	

Species	EPBC Act[1]	BC Act[2]	Note
Koala		V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act.

GOONBRI

GOONBRI ROAD

MALLEE LANE

DRIPPING ROCK ROAD

Legend

- Grey-crowned Babbler
- Little Lorikeet
- Painted Honeyeater
- Speckled Warbler
- Offset boundary
- Box Gum Woodland (State 1: Woodland) - EPBC Act
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act

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APPENDIX E-21

TITLE. IMPLEMENTATION MEASURES FOR THE GOONBRI BOA

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Baseline habitat conditions for matters of National Environmental Significance

The Goonbri BOA contains approximately 72.3 ha of the EPBC Act listed White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 88.3 ha occurs as derived native grassland (State 2: Native Pasture) Box Gum Woodland and meets the BC Act listing for this community. This ecological community is situated throughout the Goonbri BOA on the lower slopes and flatter land (Figure E-18).

The Goonbri BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox, Corben's Long-eared Bat and Large-eared Pied Bat.

E1.2.4.2 Planning

Completion criteria

The completion criteria for management of the Goonbri BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Goonbri BOA contains three offset management zones, as detailed in Table E-38 and illustrated in Figure E-22.

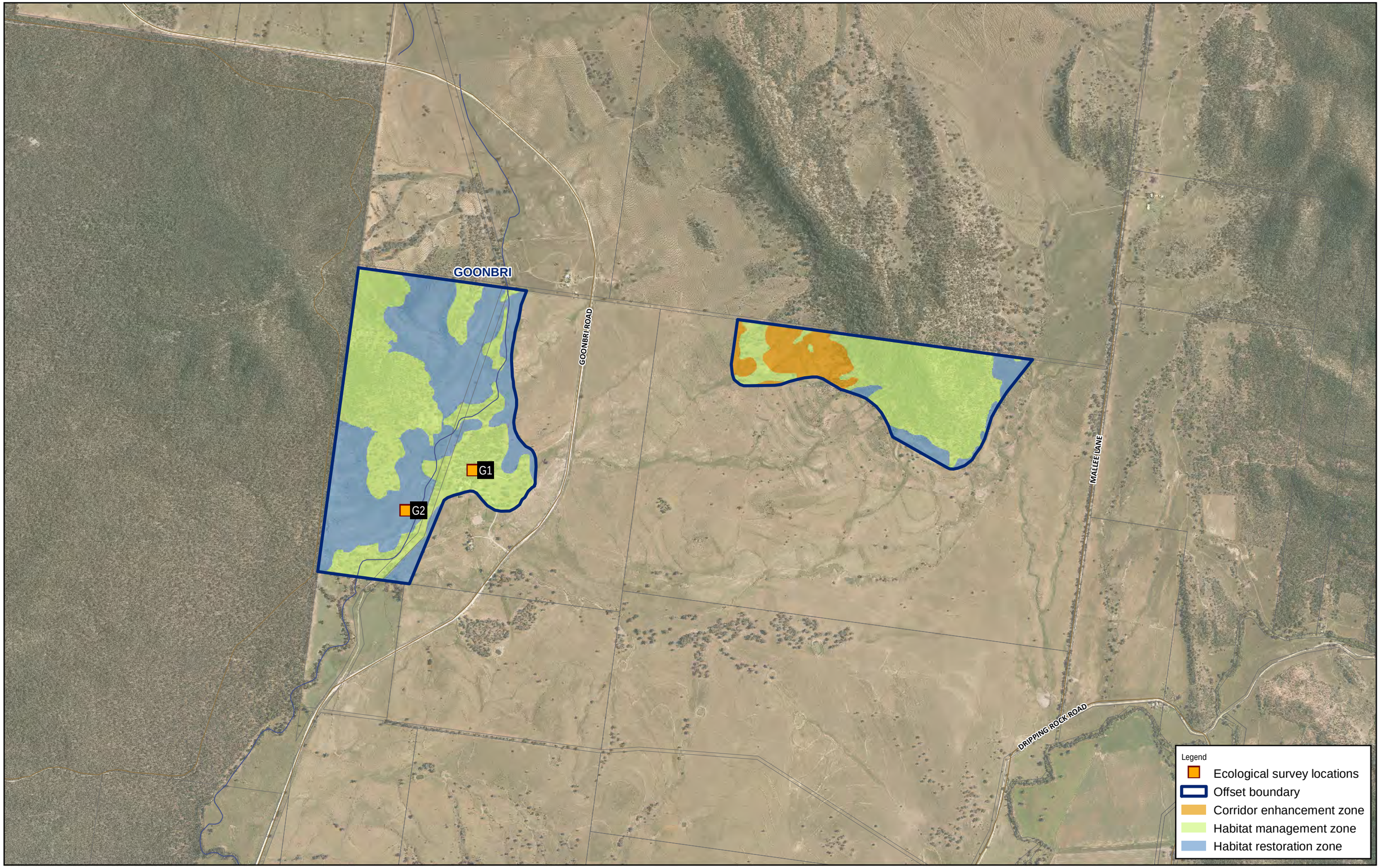
Table E-38 Offset management zones within the Goonbri BOA

Offset management zone	Area (ha)
Habitat management zone	127.6
Habitat restoration zone	88.3
Corridor enhancement	15.1
Total	**231.0**

Threats and disturbances

Existing threats and disturbances within the Goonbri BOA include:

- Clearing and fragmentation — a large proportion of the Goonbri BOA has been historically cleared now occurs as low condition woodland, derived native grassland or exotic dominated pasture (Figure E-17).
- Livestock grazing — the Goonbri BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the BOA, thereby promoting weed growth.
- Weedy exotic plants and pest animals – the Goonbri BOA contains areas of high weed density, particularly within the western area of the property, where grazing is intensified (Figure E-40). Without management intervention, weed densities within this area may increase and potentially spread into low density weed areas throughout the BOA.
- Alteration of abiotic factors (hydrology, nutrients and soil) — The Goonbri BOA contains several large ephemeral drainage lines. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities.
- Pesticides and herbicides — area if remnant native vegetation within the BOA may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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Imagery:
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APPENDIX E-22

TITLE. IMPLEMENTATION MEASURES FOR THE GOONBRI BOA

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E1.3 Namoi Offsets

E1.3.1 Namoi BOA

The Namoi River Floodplain BOA (Namoi BOA) encompasses an area of 3,214.9 ha, with the eastern extent of the BOA located approximately 1.9 km from the EIS mine disturbance limit (Boggabri Existing). A summary of the Namoi BOA is provided in Table E-39 and the site locality is illustrated in Figure E-23.

Table E-39 Summary of Namoi BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Liverpool Plains sub-catchment
Botanical Subdivision	Bordering the North Western Slopes (NWS) and North Western Plains (NWP) subdivisions
Mitchell landscapes	Liverpool Alluvial Plains Mooki - Namoi Channels and Floodplains Upper Namoi Swamps and Lagoons Bugaldie Uplands Cubbo Uplands
Noxious weed control area	Narrabri

It is noted that the Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine (Figure E-42). Boggabri Coal owns 50% of land purchased under the joint venture agreement. The Namoi BOA, as discussed in this BMP, totalling 3,214.9 ha, encompasses properties wholly owned by Boggabri Coal.

E1.3.1.1 Baseline condition

The Namoi BOA forms the south-west area of the Regional East-West Wildlife Corridor, linking the Namoi River Floodplain with Leard State Forest. The BOA supports significant areas of floodplain vegetation including numerous natural soaks associated with the Namoi River. The western portion of the Namoi BOA contains significant areas of grassy and shrubby woodland with relatively few disturbances. The vegetation and fauna habitat types present are illustrated in Figure E-23 and a breakdown is provided in Table E-40 and Table E-41.

Table E-40 Vegetation types within the Namoi BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
Belah Alluvial Woodland	PCT55 / BVT NA102: Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region	Brigalow Clay Plain Woodlands	Grassy Woodlands	Not listed	2.7

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
Belah Alluvial Woodland (low condition)	PCT55 / BVT NA102: Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region (Derived Naïve Grassland)	Brigalow Clay Plain Woodlands	Grassy Woodlands	Not listed	65.3
Dwyer's Red Gum woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	125.4
Dwyer's Red Gum woodland (low condition)	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	29.2
Pilliga Box - Poplar Box – White cypress pine grassy open forest	PCT 88 / BVT NA179: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion	Floodplain Transition Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	208.3
Pilliga Box - Poplar Box – White cypress pine grassy open forest (low condition)	PCT 88 / BVT NA179: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion (Derived Native Grassland)	Floodplain Transition Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	531.6
Plains Grassland[1]	PCT102 / BVT NA181: Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion	Western Slopes Grasslands	Grasslands	Plains Grassland[1]	20.3
River Red Gum Riparian woodland and forest[2]	PCT78 / BVT NA193: River Red Gum riparian tall woodland/ open forest wetland in	Inland Riverine Forests	Forested Wetlands	Aquatic Ecological Community of Darling River[2]	68.6

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
	the Nandewar Bioregion and Brigalow Belt South Bioregion				
River Red Gum Riparian woodland and forest (low condition)[2]	PCT78 / BVT NA193: River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Inland Riverine Forests	Grasslands	Aquatic Ecological Community of Darling River[2]	94.0
Rough-barked Apple Riparian Forbs/Grass Forest	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	7.9
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	203.8
Silver-leaved Ironbark heathy woodland (Low Condition)	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	3.5
Narrow-leaved Ironbark – White Cypress Pine shrubby open forest; Regrowth White Cypress Pine	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	444.4
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Grasslands	Not listed	7.0

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
forest (Low Condition)	(Derived Native Grassland)				
Weeping Myall Woodland[3]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	Weeping Myall Woodlands (BC Act EPBC Act)[3]	30.2
Weeping Myall Woodland (low condition) [3]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	Weeping Myall Woodlands (BC Act EPBC Act)[3]	2.3
White Box – Melaleuca riparian forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	4.6
White Box – White Cypress Pine grassy woodland[4,5]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)[4,5]	308.5
White Box – White Cypress Pine grassy woodland (Low Condition)[4,5]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)[4,5]	561.2
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west; Regrowth White Cypress Pine	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	165.4

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west (Low condition)	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	23.8
Yellow Box - Blakely's Red Gum grassy woodland[4,5]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)[4,5]	17.9
Yellow Box - Blakely's Red Gum grassy woodland (Low Condition)[4,5]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)[4,5]	28.9
Corridor enhancement	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation (Intensive Agriculture/Corridor Enhancement)	n/a	n/a	Not listed	30.3
Crop land/ other land for agriculture	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation (Crop Land/ Other Land for Agriculture)	n/a	n/a	Not listed	229.8
Total[6]					3,214.9

Notes

1 Critically Endangered Ecological Community, Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland.

2 Endangered Ecological Community, Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River FM Act.

3 Critically Endangered Ecological Community, White Box -Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the EPBC Act.

4 Endangered Ecological Community, Weeping Myall Woodlands.

5 Endangered Ecological Community, White Box – Yellow Box – Blakely's Red Gum Woodland Endangered Ecological Community listed under the BC Act.

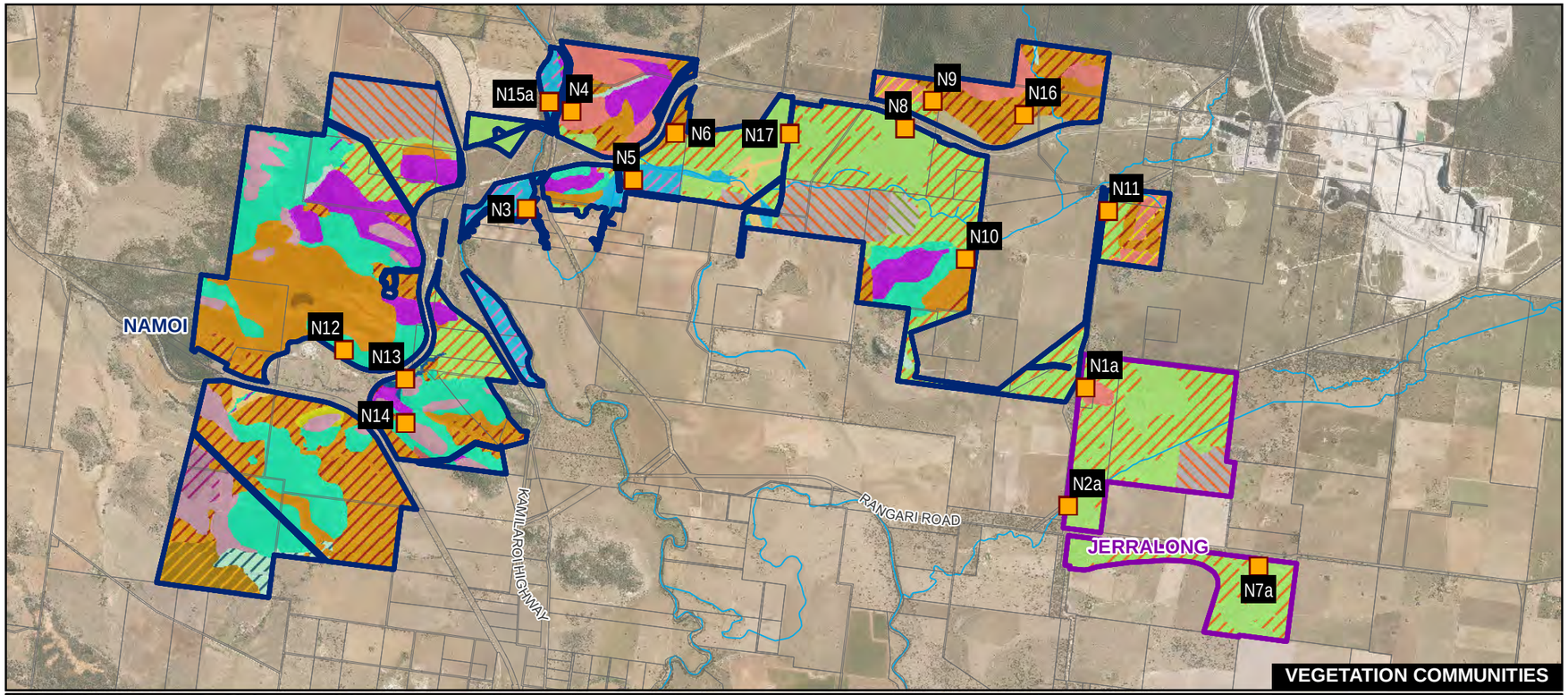
6 Total calculated on the total vegetated area of the Namoi BOA minus 50% of the joint ownership property area.

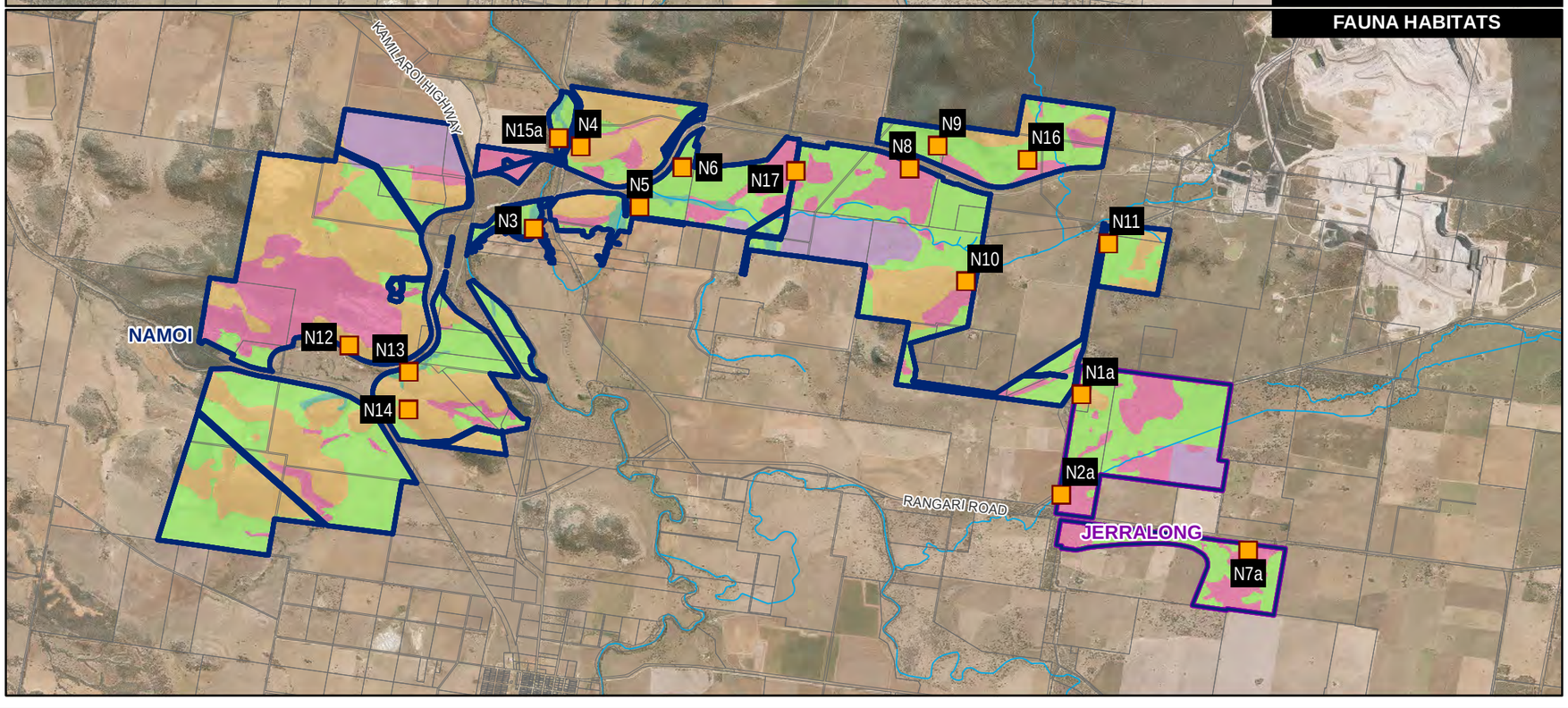
7 Low condition refers to Derived Native Grasslad and regrowth Callitris.

Table E-41 Fauna habitat types within the Namoi BOA

Fauna habitat	Area (ha)
Grassland	1,368.9
Grassy woodland on fertile soils	567.6
Shrubby woodlands/Open forest on skeletal soils	939.0
Riverine woodland	81.1
Other land for agriculture	258.3
Total[1]	**3,214.9**

Note:
1 Total calculated on the total vegetated area of the Namoi BOA minus 50% of the joint ownership property area.





VEGETATION COMMUNITIES

FAUNA HABITATS

Ecological survey location

Offset boundary - unique

Offset boundaries

- Namoi offset
- Jerralong offset

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region

- Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region [PCT55/NA102]
- Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region - Derived Native Grassland [PCT55/NA102]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

- Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]
- Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range - Derived Native Grassland [PCT610/NA245]

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion

- Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [PCT102/NA181]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

- Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]
- Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

- Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]
- Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

- River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion

- River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT78/NA193]

- River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT78/NA193]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

- Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [PCT27/NA219]
- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT27/NA219]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1384/NA227]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1384/NA227]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

- White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]
- White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

- White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]
- White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion - Derived Native Grassland [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]
- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion - Derived Native Grassland [PCT1329/237]

Miscellaneous

- Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low
- Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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APPENDIX E-23

TITLE. VEGETATIN AND FAUNA HABITATS OF THE NAMOI BOA

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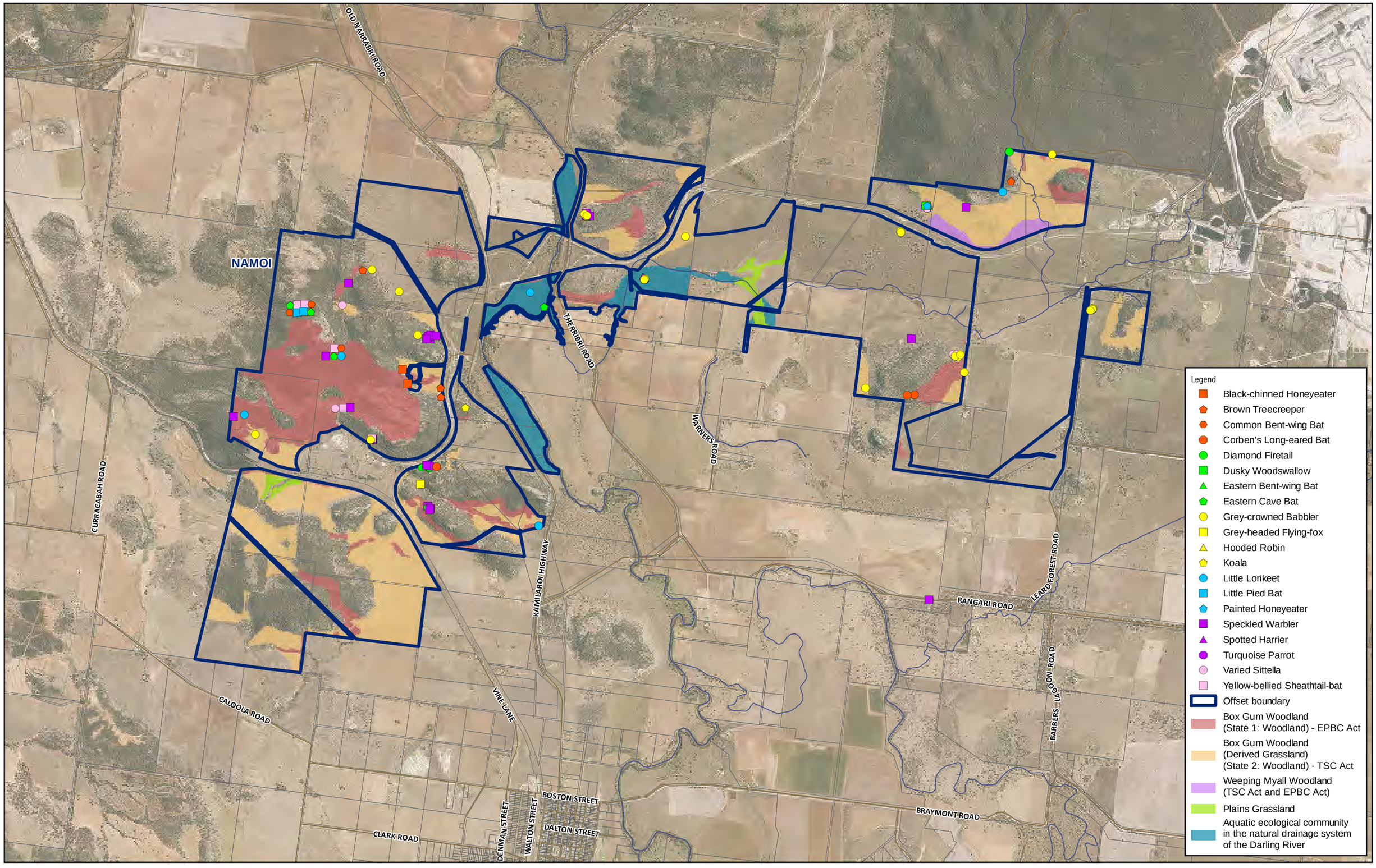
Table E-42 summarises the threatened species recorded or predicted to occur within the Namoi BOA. Threatened species and ecological communities recorded within the Namoi BOA are illustrated in Figure E-24.

Table E-42 Threatened species recorded or predicted to occur within the Namoi BOA

Species	EPBC Act[1]	BC Act[2]	FM Act[3]	Note
Threatened Ecological Communities				
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling Rive			E	Recorded
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland	CE	E		
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E		
Weeping Myall Woodlands	E	E		
Flora				
Digitaria Porrecta	E	E1		Potential habitat
Pomaderris queenslandica		E1		
Diuris tricolor	V	V		
Fauna				
Birds				
Black Falcon		V		Recorded
Black-chinned Honeyeater		V		
Brown Treecreeper		V		
Diamond Firetail		V		
Dusky Woodswallow		V		
Grey-crowned Babbler		V		
Hooded Robin		V		
Little Eagle		V		
Little Lorikeet		V		
Painted Honeyeater		V		
Masked Owl		V		
Speckled Warbler		V		
Spotted Harrier		V		
Turquoise Parrot		V		
Varied Sittella		V		
Pied Honeyeater		V		Potential habitat
Regent Honeyeater	CE	CE		
Square-tailed Kite		V		

Species	EPBC Act[1]	BC Act[2]	FM Act[3]	Note
Superb Parrot	V	V		
Swift Parrot	CE	E1		
Mammals				
Eastern Cave Bat		V		Recorded
Eastern Bent-wing Bat		V		
Corben's Long-eared Bat	V	V		
Grey-headed Flying-fox	V	V		
Yellow-bellied Sheathtail Bat		V		
Little Pied Bat		V		
Koala		V		
Eastern False Pipistrelle		V		Potential habitat
Large-eared Pied Bat	V	V		
Spotted-tailed Quoll	E	V		
Reptiles				
Border Thick-tailed Gecko	V	V		Potential habitat
Pale-headed Snake		V		Potential habitat
Amphibians				
Sloane's Froglet		V		Potential habitat

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E), Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act
3 Listed as Endangered (E) under the FM Act.



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APPENDIX E-24

TITLE. IMPLEMENTATION MEASURES FOR THE NAMOI BOA

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Baseline habitat conditions for matters of National Environmental Significance

The Namoi BOA contains three threatened ecological communities that occur as MNES (Figure E-24). including:

- 326.4 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 590.1 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the BC Act listing for this community.
- 20.3 ha of the EPBC Act listed Critically Endangered Ecological Community Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland (Plains Grassland).
- 30.2 ha of the EPBC Act listed Endangered Ecological Community Weeping Myall Woodlands. A further 2.3 ha of this ecological community occurs as derived native grassland.

Corben's Long-eared Bat, which is listed as Vulnerable under the EPBC Act has been recorded in two disparate locations of the Namoi BOA (Figure E-24). The Namoi BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox and Large-eared Pied Bat.

E1.3.1.2 Planning

Completion criteria

The completion criteria for management actions within the Namoi BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Namoi BOA contains four offset management zones, as detailed in Table E-43 and illustrated in Figure E-25.

Table E-43 Offset management zones within the Namoi BOA

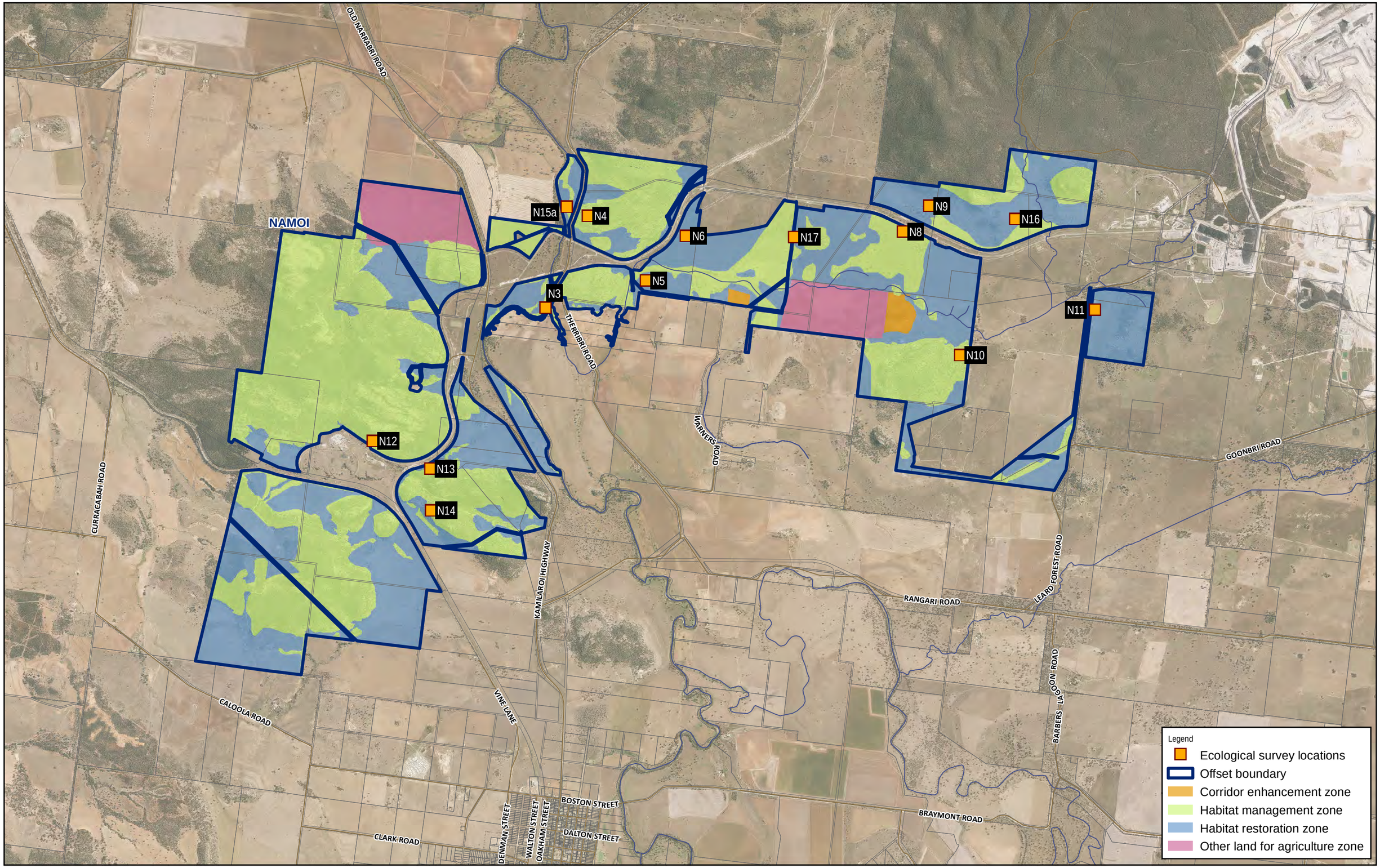
Offset management zone	Area (ha)
Habitat management zone	1,563.4
Habitat restoration zone	1,391.4
Corridor enhancement zone	30.3
Other lands for agriculture zone	229.8
Total	**3,214.9**

Threats and disturbances

Existing threats and disturbances within the Namoi BOA include:

- Clearing and fragmentation — a large proportion of the Namoi BOA has been historically cleared and now occurs as low condition woodland, derived native grassland or exotic dominated pasture (Figure E-23).
- Livestock grazing – a significant proportion of the Namoi BOA is currently grazed by cattle and sheep. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the BOA, thereby promoting weed growth.

- Weedy exotic plants and pest animals — The Namoi BOA contains areas of high weed density, particularly within the riparian zone of the Namoi River which is dominated by herbaceous weeds (Figure E-43). Without management intervention, weed densities within these areas are likely to increase and potentially spread into areas supporting low and moderate weed densities throughout the BOA.
- Pest animals of concern within the Namoi BOA include Rabbits, Goats and Pigs. These feral pests are known to damage soil, prohibit native species regeneration and compete for food resources with native species.
- Alteration of abiotic factors (hydrology, nutrients and soil) — The Namoi BOA contains several large ephemeral drainage lines and the Namoi River, where significant areas of erosion have been identified. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities.
- Pesticides and herbicides — areas of remnant vegetation within BOA boundaries may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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APPENDIX E-25

TITLE. IMPLEMENTATION MEASURES FOR THE NAMOI BOA

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E1.3.2 Jerralong BOA

The Jerralong BOA encompasses an area of 570.1 ha and is located approximately 2.8 km from the EIS mine disturbance limit (Boggabri Existing). The Jerralong BOA adjoins to the south-east of the Namoi BOA and provides offsets for the original project approval and subsequent project modifications. A summary of the Jerralong BOA is provided in Table E-44.

Table E-44 Summary of Jerralong BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Liverpool Plains sub-catchment
Botanical Subdivision	Bordering the North Western Slopes (NWS) and North Western Plains (NWP) subdivisions
Mitchell landscapes	Liverpool Alluvial Plains Mooki - Namoi Channels and Floodplains Upper Namoi Swamps and Lagoons Bugaldie Uplands Cubbo Uplands
Noxious weed control area	Narrabri

E1.3.2.1 Baseline condition

The Jerralong BOA forms part of the Namoi BOA's eastern edge where it widens the Nandewar Range to Namoi River corridor south of the project. It represents a section of the Namoi River floodplain that is traversed by Bollol Creek east of its confluence with the Namoi River. The Jerralong BOA has been used as grazing land in the past and much of it remains as open grassland habitats with remnant woodlands dominated by Poplar Box *(Eucalyptus populneus*), White Box *(E.* albens) and stony rises dominated by White Cypress Pine *(Callitris glaucophylla*). The vegetation and fauna habitat types present are illustrated in Figure E-26 and a breakdown is provided in Table E-45 and Table E-46

Table E-45 Vegetation types within the Jerralong BOA

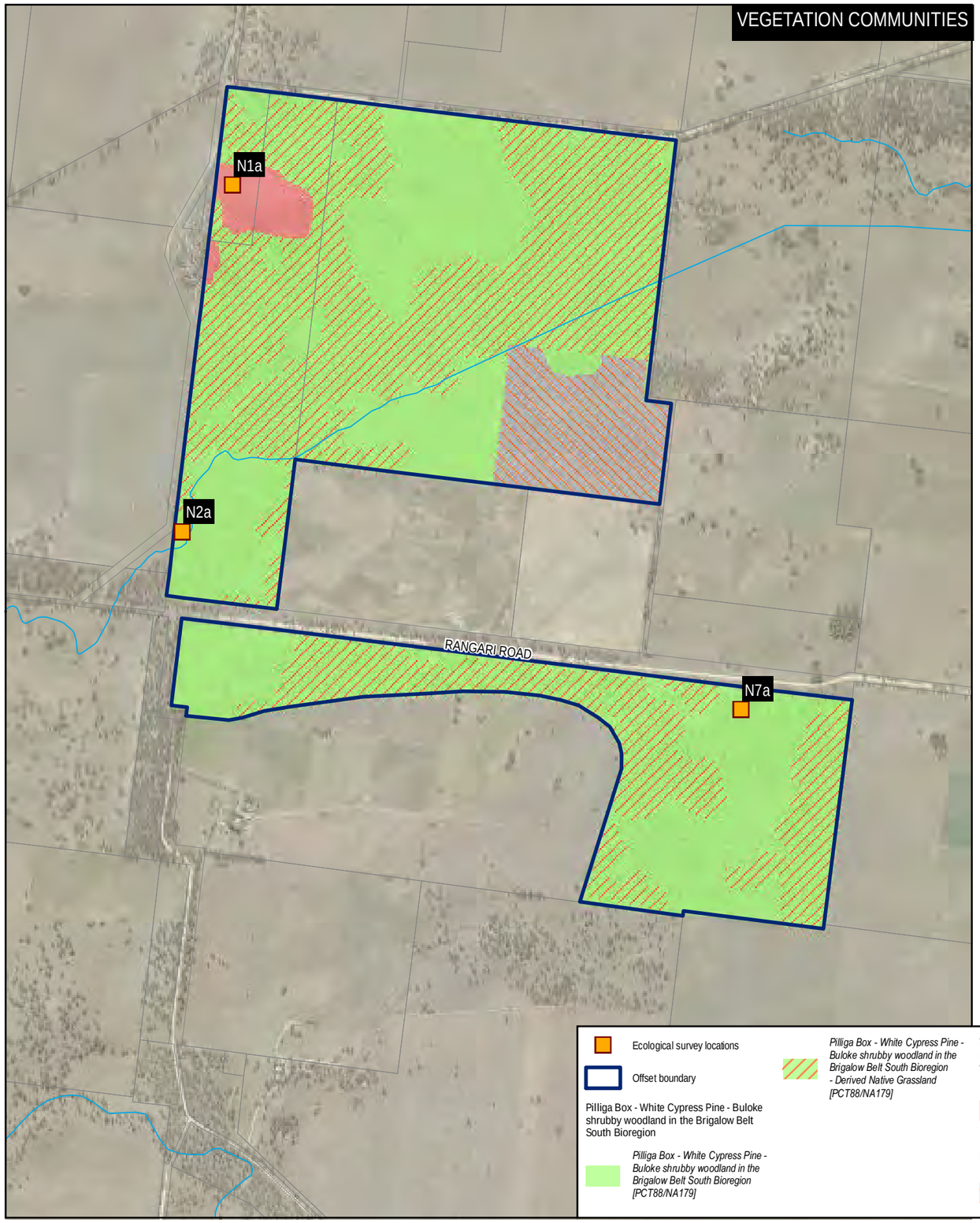
Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
Pilliga Box - Poplar Box – White cypress pine grassy open forest	PCT88 / BVT NA179: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion	Floodplain Transition Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	209.0
Pilliga Box - Poplar Box – White cypress pine grassy open forest (low condition)	PCT88 / BVT NA179: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion (Derived Native Grassland)	Floodplain Transition Woodlands	Grasslands	Not listed	300.8
White Pine/Narrow-leaved Ironbark Shrub/Grass	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass	Northern Tableland Dry	Dry Sclerophyll Forests (Shrubby	Not listed	13.4

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation Formation	Threatened ecological community	Area (ha)
Open Forest; south-west	open forest of the western Nandewar Bioregion	Sclerophyll Forests	sub-formation)		
Exotic grassland/ crop land/ other land for agriculture	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	46.9
				Total	**570.1**

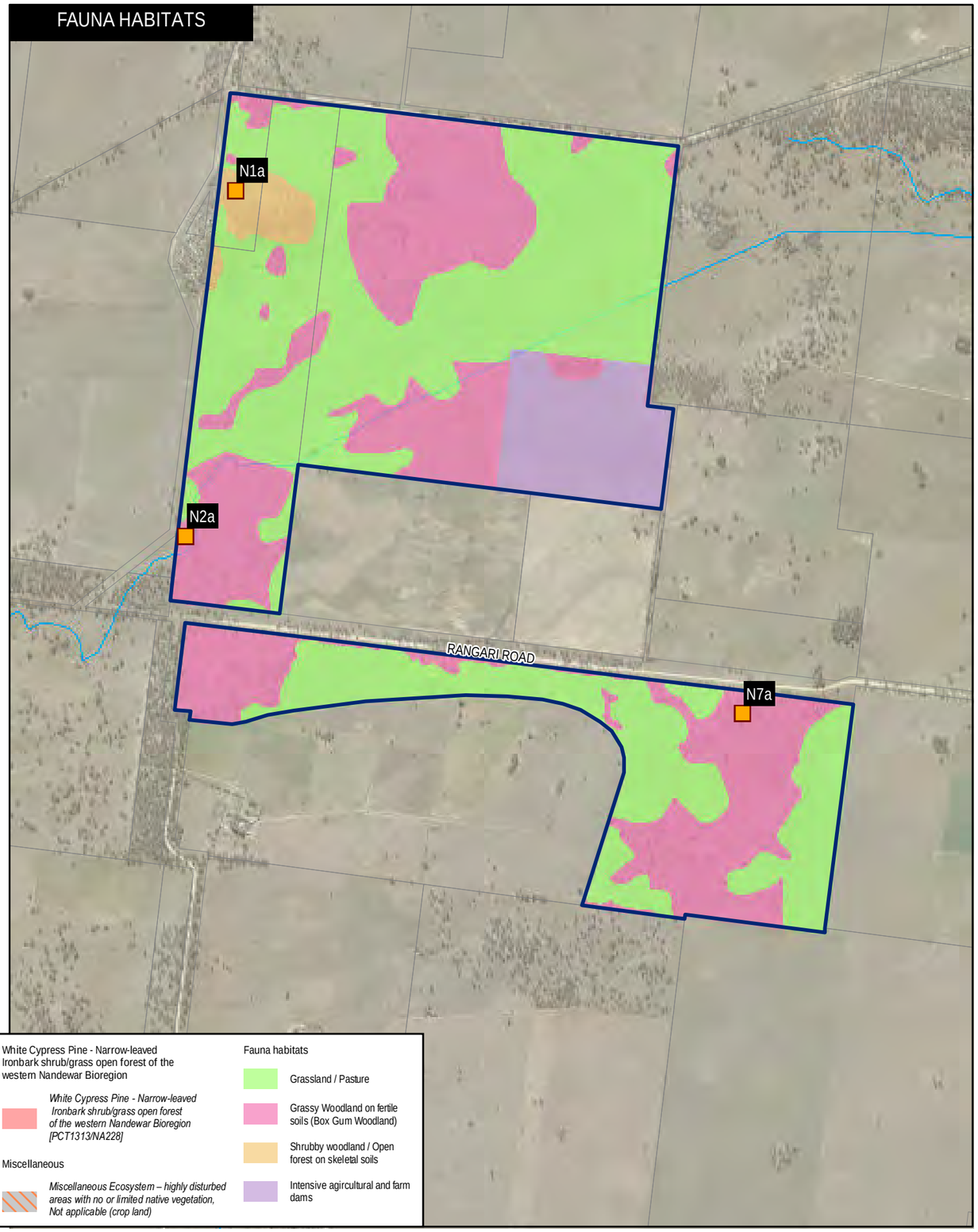
Table E-46 Fauna habitat types within the Jerralong BOA

Fauna habitat	Area (ha)
Grassy woodland on fertile soils	209.0
Shrubby woodlands/Open forest on skeletal soils	13.4
Grassland / Pasture	300.8
Other land (intensive agriculture)	46.9
Total	**570.1**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

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APPENDIX E-26

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE JERRALONG BOA

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Table E-47 summarises the threatened species recorded or predicted to occur within the Jerralong BOA. Threatened species and ecological communities recorded within the Jerralong BOA are illustrated in Figure E-27.

Table E-47 Threatened species recorded or predicted to occur within the Jerralong BOA

Species	EPBC Act[1]	BC Act[2]	Note
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Grey-crowned Babbler		V	Recorded
Little Eagle		V	
Spotted Harrier		V	
Little Lorikeet		V	Potential habitat
Barking Owl		V	
Brown Treecreeper		V	
Dusky Woodswallow		V	
Painted Honeyeater		V	
Speckled Warbler		V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Black-chinned Honeyeater		V	
Diamond Fire-tail		V	
Hooded Robin		V	
Masked Owl		V	
Rainbow Bee-eater	M		
Regent Honeyeater	CE	CE	
Pied Honeyeater		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Mammals			
Yellow-bellied Sheathtail Bat		V	Recorded
Eastern Cave Bat		V	Potential habitat
Squirrel Glider		V	
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Koala		V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	

Species	EPBC Act[1]	BC Act[2]	Note
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act

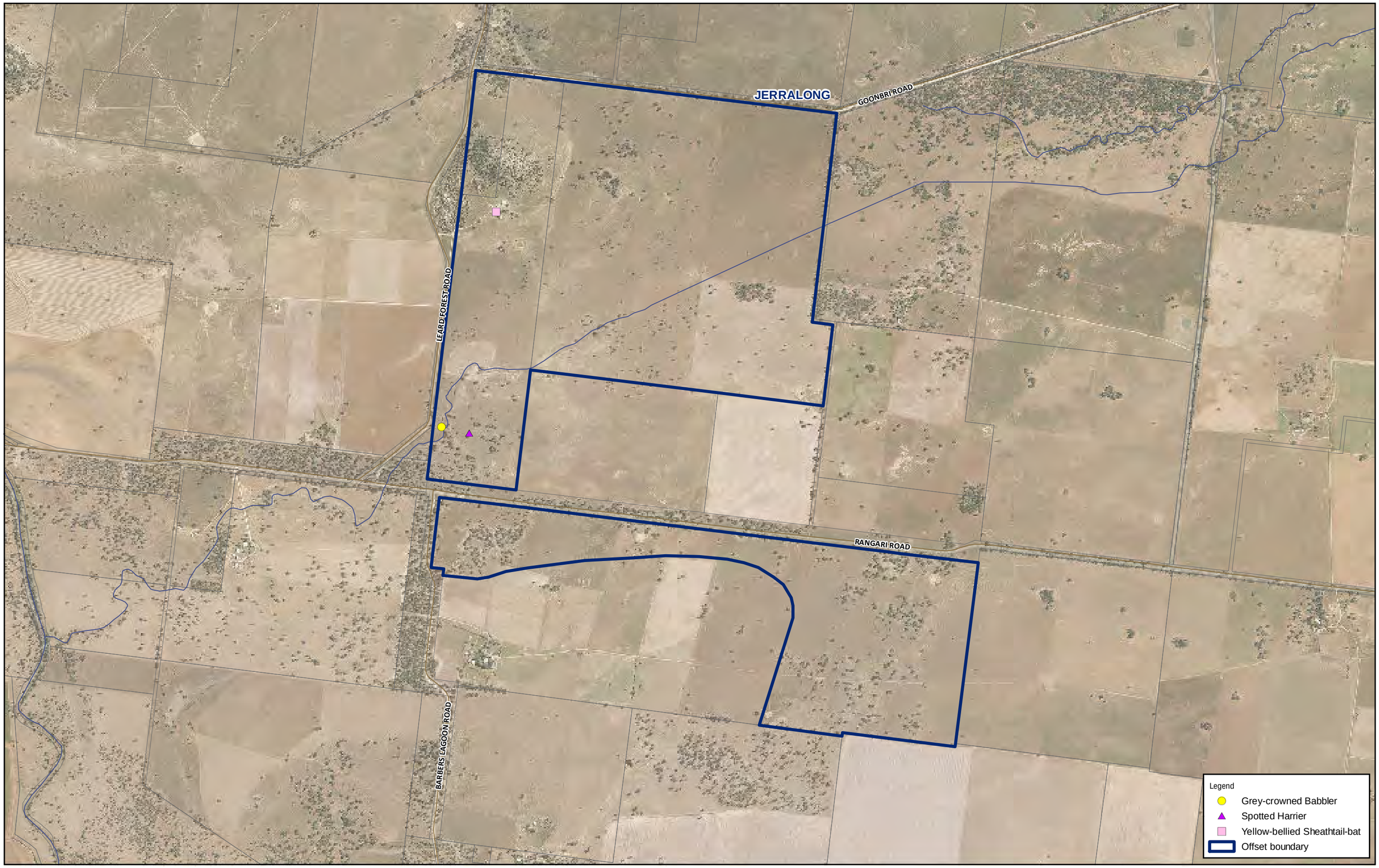
Baseline habitat conditions for matters of National Environmental Significance

No threatened ecological communities listed under the EPBC Act have been recorded in the Jerralong BOA. Notwithstanding this, the Jerralong BOA provides suitable habitat for the Regent Honeyeater, Swift Parrot and Superb Parrot.

E1.3.2.2 Planning

Completion criteria

The completion criteria for management of the Jerralong BOA are provided in Section 7.3 of the main BMP document.



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APPENDIX E-27

TITLE. IMPLEMENTATION MEASURES FOR THE JERRALONG BOA

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Offset management zones

The Jerralong BOA contains three offset management zones, as detailed in Table E-48 and illustrated in Figure E-28.

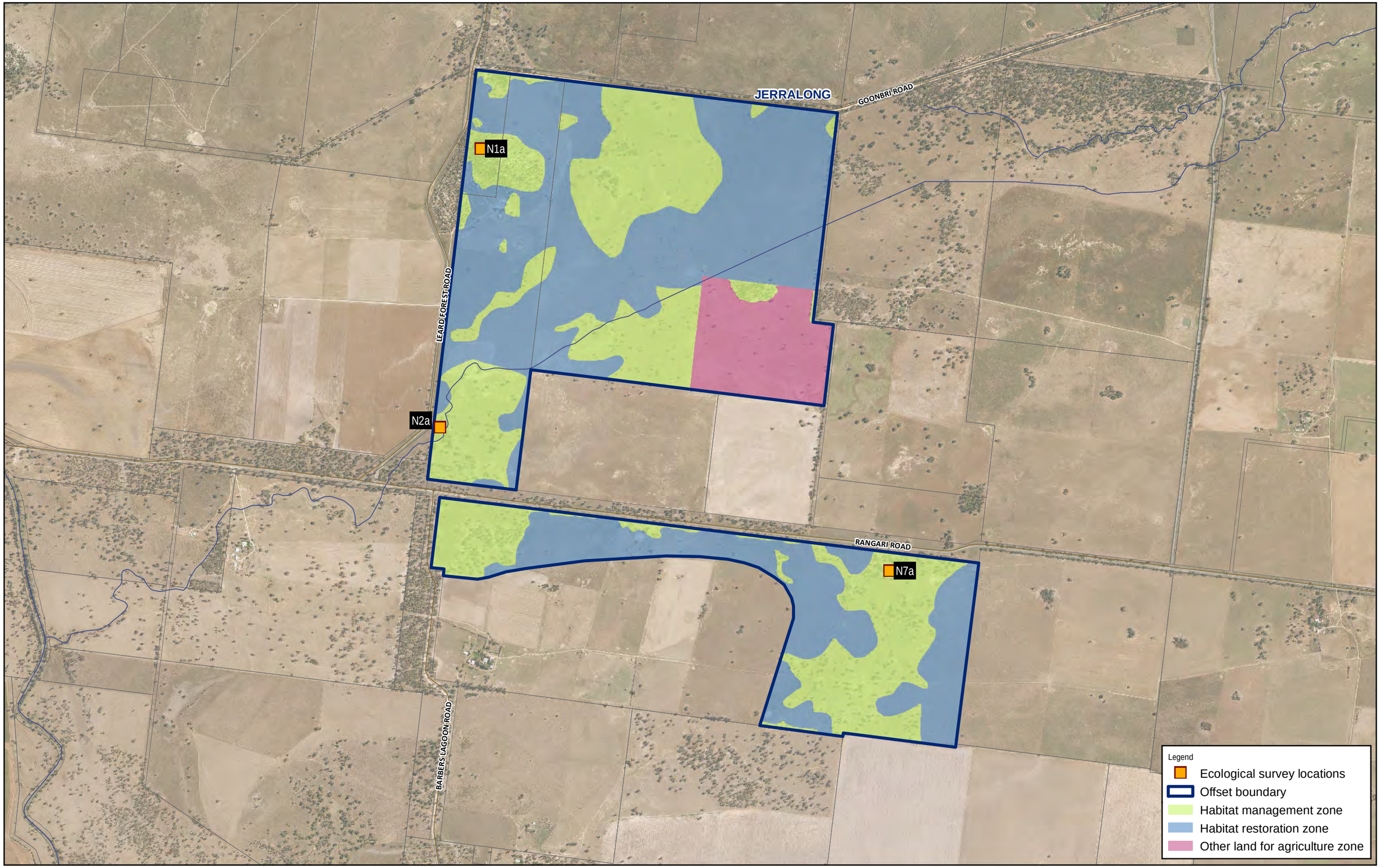
Table E-48 Offset management zones within the Jerralong BOA

Offset management zone	Area (ha)
Habitat management zone	222.4
Habitat restoration zone	300.8
Other lands for agriculture zone	46.9
Total	**570.1**

Threats and disturbances

Existing threats and disturbances within the Jerralong BOA include:

- Clearing and fragmentation — a large proportion of the Jerralong BOA has been historically cleared now occurs as low condition woodland, derived native grassland or exotic dominated pasture (Figure E-17).
- Livestock grazing — the Goonbri BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the BOA, thereby promoting weed growth.
- Weedy exotic plants and pest animals – the Jerralong BOA contains areas of high weed density, where grazing and cropping is intensified (Figure E-40). Without management intervention, weed densities may increase and potentially spread into low density weed areas throughout the BOA.
- Pesticides and herbicides — areas of remnant native vegetation within the BOA may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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APPENDIX E-28

TITLE. IMPLEMENTATION MEASURES FOR THE JERRALONG BOA

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E1.4 Western Offsets

E1.4.1 Merriendi BOA

The Merriendi BOA encompasses an area of 483.2 ha and is located approximately 8.3 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Merriendi BOA is provided in Table E-49 and the site locality is illustrated in Figure E-1.

Table E-49 Summary of Merriendi BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Liverpool Plains sub-catchment
Botanical Subdivision	Bordering the North Western Slopes (NWS) and North Western Plains (NWP) subdivisions
Mitchell landscapes	Bugaldie Uplands Liverpool Alluvial Plains
Noxious weed control area	Narrabri

E1.4.1.1 Baseline condition

The Merriendi BOA forms the north-west corner of the Regional East-West Wildlife Corridor. The north east boundary of the BOA adjoins approximately 1.7 km of the Leard State Conservation Area, which was gazetted in 2005 under the BNCCA Act.

The Merriendi BOA supports large areas of high quality woodland habitats characterised by native grasses, fallen timber, leaf litter and loose rock. The vegetation and fauna habitat types present are illustrated in Figure E-29 and a breakdown is provided in Table E-50 and Table E-51.

Table E-50 Vegetation types within the Merriendi BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
Dwyer's Red Gum Woodland (includes regrowth White Cypress Pine)	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not Listed	130.2
Pilliga Box – Poplar Box – white cypress pine grassy open forest (Low Condition)	PCT88 / BVT NA179: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South	Western Slopes Grassy Woodlands	Grassy Woodlands		4.4

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation Class	Vegetation formation	Threatened ecological community	Area (ha)
	Bioregion (Derived Native Grassland)				
White Box – White Cypress Pine grassy woodland[1]	PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	176.1
White Box – White Cypress Pine grassy woodland (Low Condition)[2]	PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (BC Act & EPBC Act)	150.5
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not Listed	20.4
Weeping Myall Woodland[3]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	Weeping Myall Woodlands (BC Act EPBC Act)	1.6
Total					**483.2**

Notes:

1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

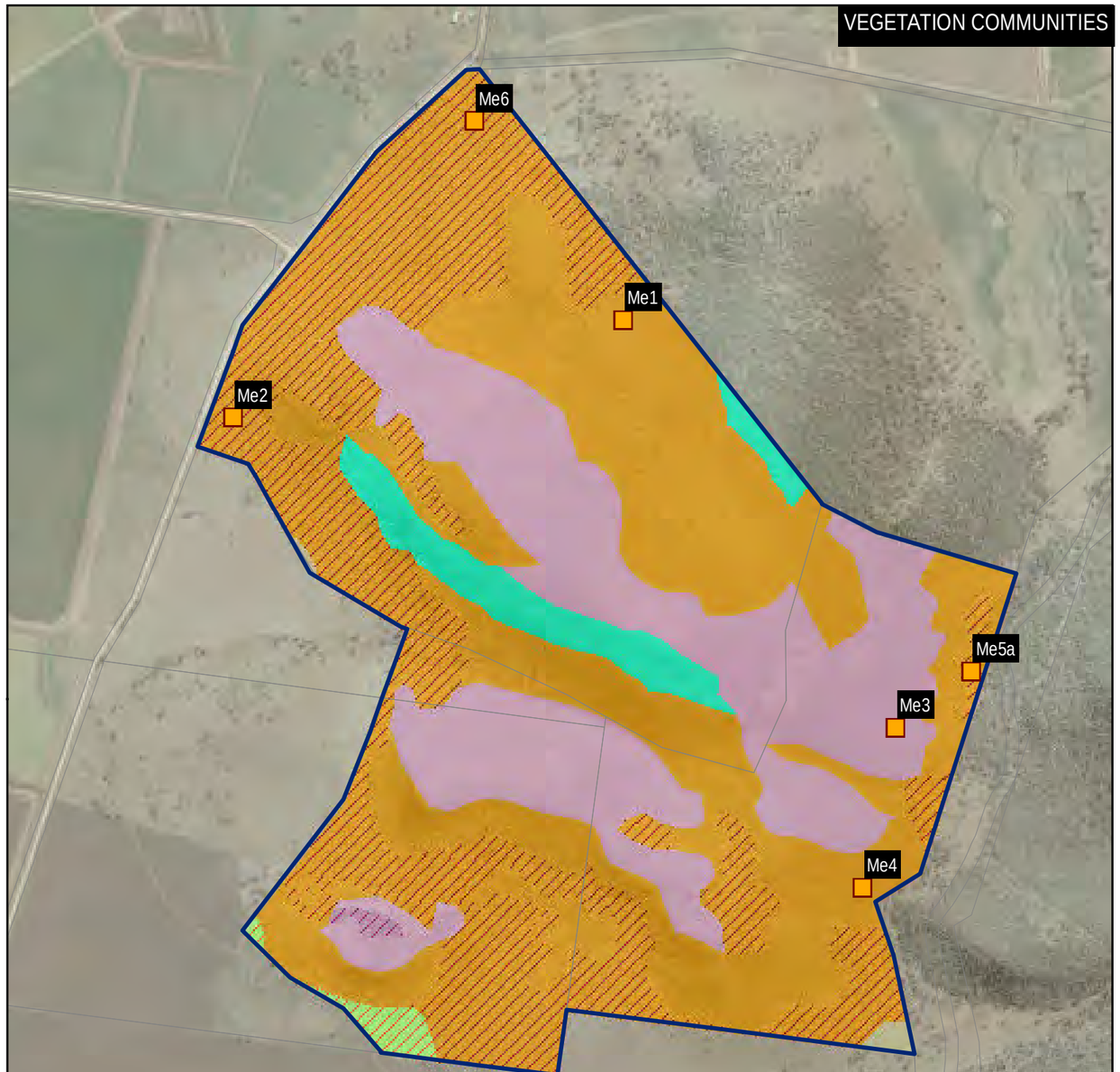
2 Commensurate with State 2 Derived Native Grassland BC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, 3 = Equivalent to Weeping Myall Woodlands listed on both the BC Act and EPBC Act.

3 Low condition refers to Derived Native Grasslands and regrowth Callitris.

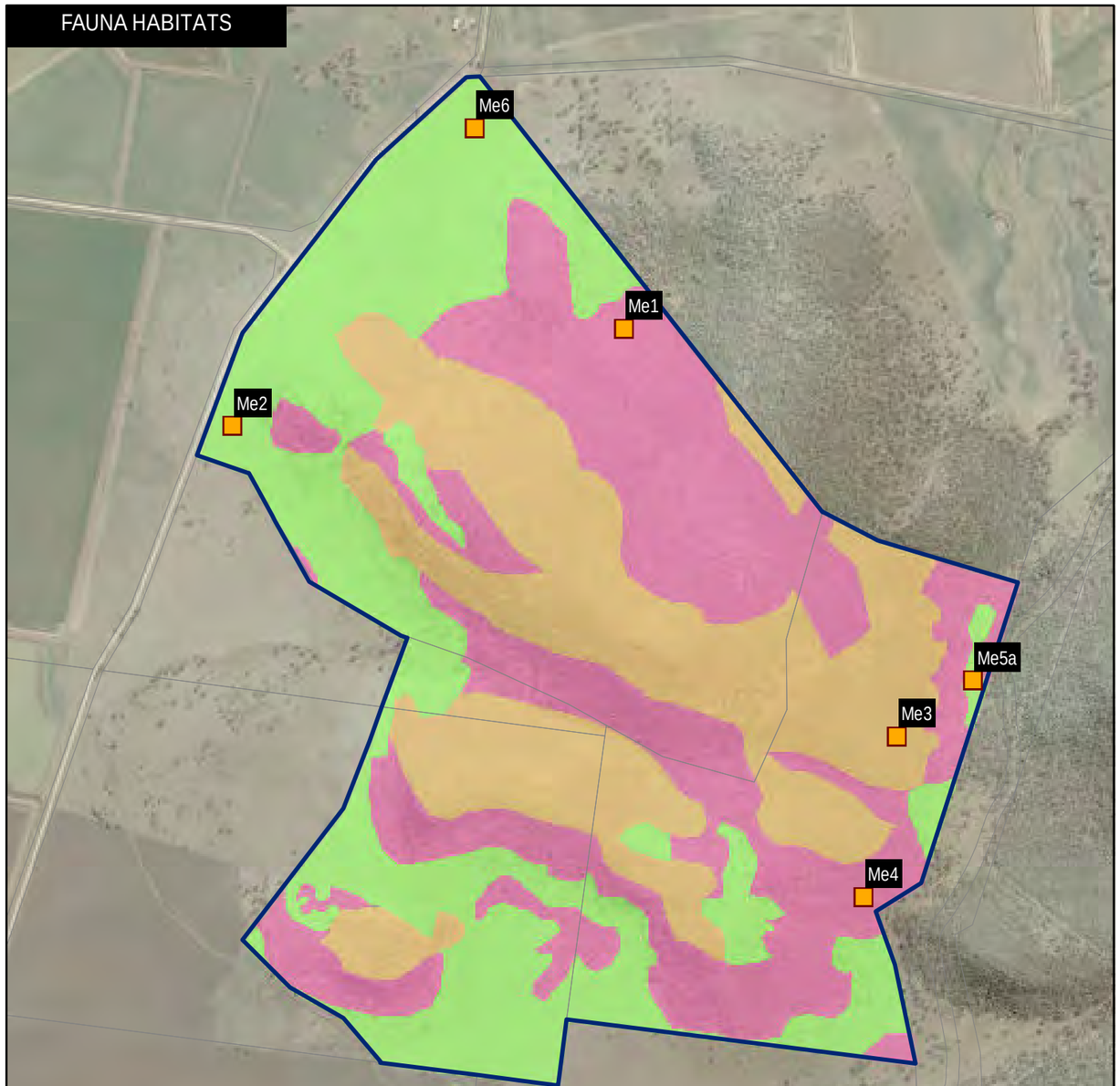
Table E-51 Fauna habitat types within the Merriendi BOA

Fauna habitat	Area (ha)
Grassland / Pasture	154.9
Grassy woodland on fertile soils	177.7
Shrubby Woodlands/Open forest on skeletal soils	150.6
Total	**483.2**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range - Derived Native Grassland [PCT610/NA245]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [PCT27/NA219]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

Fauna habitats

Grassland / Pasture

Grassy Woodland on fertile soils (Box Gum Woodland)

Shrubby woodland / Open forest on skeletal soils

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

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APPENDIX E-29

TITLE. VEGETATION COMMUNITIES AND FAUNA HABITATS WITHIN THE MERRIENDI BOA

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Table E-52 summarises the threatened species recorded or predicted to occur within the Merriendi BOA. Threatened species and ecological communities recorded within the Merriendi BOA are illustrated in Figure E-30.

Table E-52 Threatened species recorded or predicted to occur within the Merriendi BOA

Species	EPBC Act[1]	BC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Weeping Myall Woodlands	E	E	
Flora			
Digitaria porrecta	E	E1	Recorded on site with an estimated population exceeding 250 plants
Pomaderris queenslandica		E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Diamond Firetail		V	
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Lorikeet		V	
Masked Owl		V	
Painted Honeyeater		V	
Speckled Warbler		V	
Spotted Harrier		V	
Turquoise Parrot		V	
Varied Sittella		V	
Barking Owl		V	Potential habitat
Black-chinned Honeyeater		V	
Little Eagle		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Mammals			
Eastern Cave Bat		V	Recorded
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	

Species	EPBC Act[1]	BC Act[2]	Note
Yellow-bellied Sheathtail Bat		V	
Corben's Long-eared Bat	V	V	Potential habitat
Koala		V	
Spotted-tailed Quoll	E	V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	
Amphibians			
Sloane's Froglet		V	Potential habitat

Notes:
1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the BC Act

Baseline habitat conditions for matters of National Environmental Significance

The Merriendi BOA contains approximately 176.1 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland as per the methodology set out in Section 6.2.1 of main BMP document. A further 150.5 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the BC Act listing for this community. This ecological community is situated throughout the Merriendi BOA on lower slopes and flatter land (Figure E-30).

In addition Merriendi BOA contains 1.6 ha of Weeping Myall Woodland which is listed as Endangered under the EPBC Act.

The Merriendi BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox, Corben's Long-eared Bat and Large-eared Pied Bat.

THERRIBRI ROAD

MERRIENDI

Legend

- Brown Treecreeper
- Diamond Firetail
- Eastern Cave Bat
- Grey-crowned Babbler
- Hooded Robin
- Little Eagle
- Little Lorikeet
- Speckled Warbler
- Spotted Harrier
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheathtail-bat
- Offset boundary
- Box Gum Woodland (State 1: Woodland) - EPBC Act
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act
- Weeping Myall Woodland (TSC Act and EPBC Act)

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Projection: Transverse Mercator
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APPENDIX E-30

TITLE. IMPLEMENTATION MEASURES FOR THE MERRIENDI BOA

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E1.4.1.2 Planning

Completion criteria

The completion criteria for management actions within the Merriendi BOA are provided in Section 7.3 of the main BMP document.

Offset management zones

The Merriendi BOA contains two offset management zones, as detailed in Table E-53 and illustrated in Figure E-31.

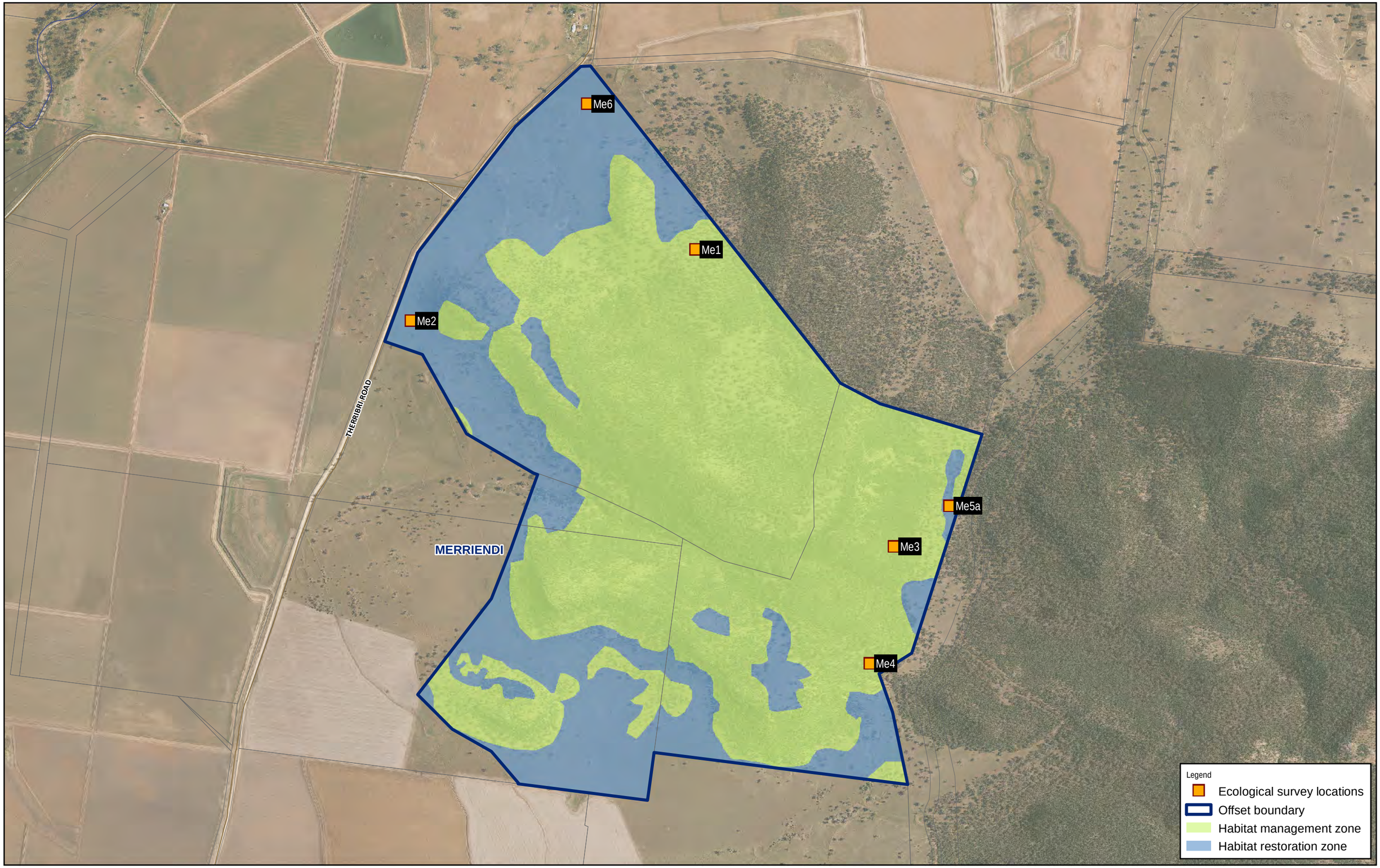
Table E-53 Offset management zones within the Merriendi property

Offset management zone	Area (ha)
Habitat management zone	327.1
Habitat restoration zone	156.2
Total	**483.3**

Threats and disturbances

Existing threats and disturbances within the Merriendi BOA include:

- Clearing and fragmentation – a large proportion of the Merriendi BOA supports remnant woodland; however areas which have been historically cleared and now occurs as low condition woodland, derived native grassland, exotic dominated pasture or agricultural crops (Figure E-29).
- Livestock grazing – The Merriendi BOA is currently grazed by livestock. The existing grazing regime is likely to be reducing the potential for native species regeneration and increasing nutrient loads across the BOA, thereby promoting weed growth.
- Weedy exotic plants and pest animals – The habitat management zone, which constitutes a large proportion of the Merriendi BOA, contains a low abundance of weeds and pests (Figure E-46). The density of weeds and pests increases to moderate and high in areas adjoining pasture and croplands along the south and west BOA boundary.
- Alteration of abiotic factors (hydrology, nutrients and soil) – The Merriendi BOA contains several large ephemeral drainage lines. In the absence of management intervention, erosion within these areas is likely to intensify through natural processes such as flooding or inappropriate land use activities.
- Pesticides and herbicides – land adjoining the south and west BOA boundaries may be subjected to spray drift or chemical run-off from adjoining agricultural land.



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APPENDIX E-31

TITLE. IMPLEMENTATION MEASURES FOR THE MERRIENDI BOA

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E2. Implementation of management measures

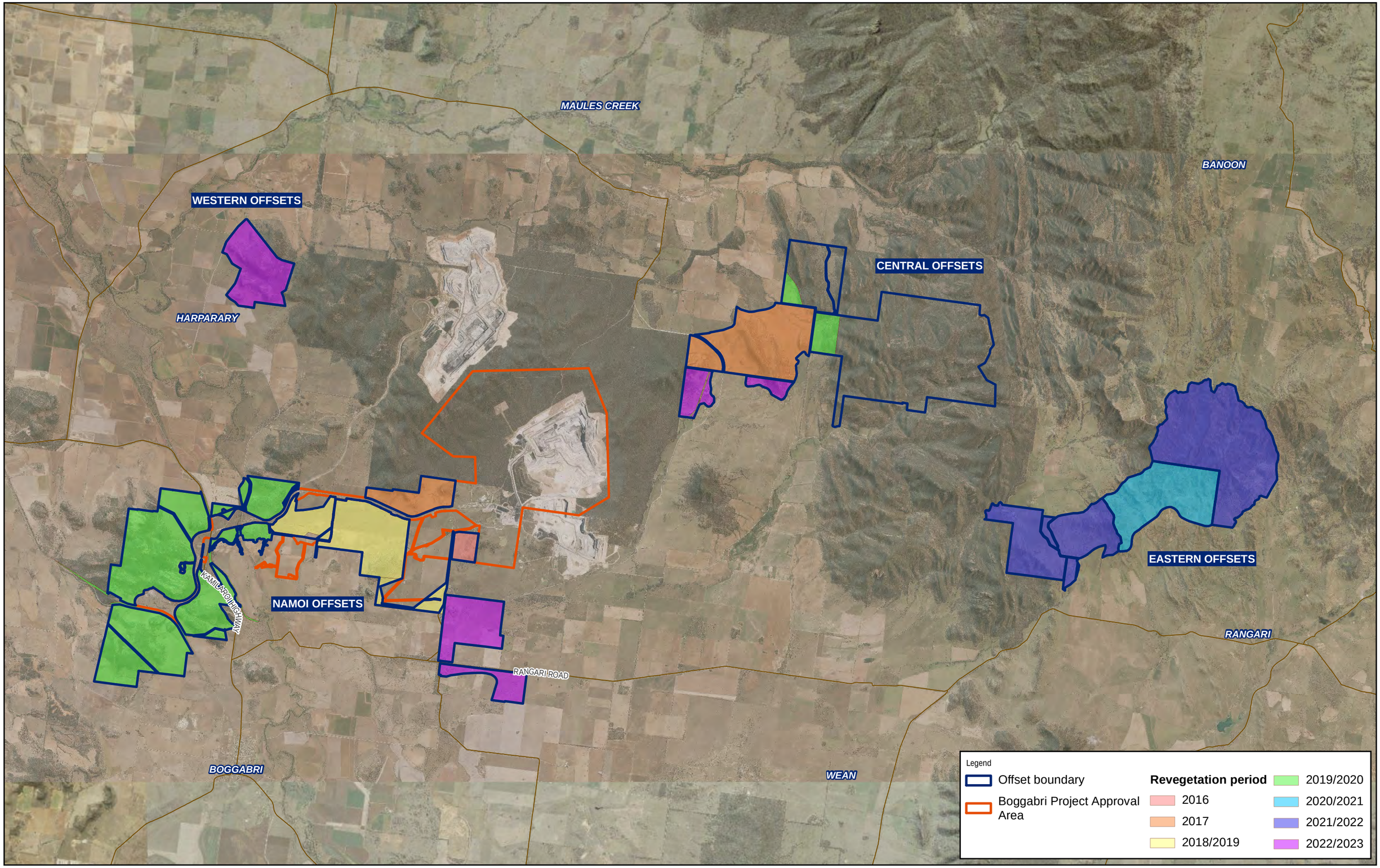
The ten BOAs have been separated into four management areas based broadly on their location in the landscape and management measures they require. Separating the BOAs into these four management areas allows for greater ease in managing and implementing the management measures successfully. The four management areas include:

- Eastern Offsets –Braefield, Sunshine and Nioka North BOAs
- Central Offsets – Mallee, Myall Plains, Wirrilah and Goonbri BOAs
- Namoi Offsets – Jerralong and Namoi BOAs
- Western Offsets – Merriendi BOA.

These four management areas are illustrated in Figure E-1. Specifically this section provides details regarding the following for each of these management areas:

- maintenance, enhancement and restoration measures
- target implementation schedule
- monitoring and evaluation.

All Habitat Restoration Zones and Corridor Enhancement Zones within each of these BOAs require large scale revegetation works. The scope and scale of revegetation works will be reviewed on an annual basis including areas to be targeted and methods to be employed. Figure E-32 provides a preliminary indication of the revegetation works proposed across all offsets. These locations will be refined and confirmed on an annual basis.



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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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APPENDIX E-32

TITLE. PRELIMINARY REVEGETATION PLAN

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E2.1 Eastern Offsets

E2.1.1 Overview

The Eastern Offsets is comprised of three BOA properties; Nioka North, Sunshine and Braefield. These three BOAs are located within the Nandewar Range and form part of the eastern section of the Regional East-West Wildlife Corridor. Figure E-33 provides an overview of the Eastern Offsets in a local context.

E2.1.2 Maintenance, enhancement and restoration measures

Figure E-34, Figure E-35 and Figure E-36 illustrate baseline weed densities, monitoring locations, revegetation zones and the proposed layout of permanent fencing and restricted access signage. Target implementation measures for the Eastern Offsets are provided in Table E-54. It is noted that these implementation measures will be amended as required and reviewed at least every twelve months. Specific implementation measures are detailed in the following sections.

E2.1.2.1 Fencing

The layout of permanent fencing proposed for the Eastern Offsets area illustrated in Figure E-34, Figure E-35 and Figure E-36. These layouts has been developed to exclude livestock from areas within the property and delineate areas based on environmental conditions and conflicting management measures. Existing boundary fencing will be replaced or upgraded to comply with the overarching management controls and minimum fencing design standards detailed in Section 6.2.2 of the main BMP document.

The current fence condition within the Eastern Offsets is variable. Fencing within the Braefield BOA is in good condition whist fencing in Nioka North and Sunshine is in generally moderate to good condition (Photo E-1, Photo E-2 and Photo E-3).

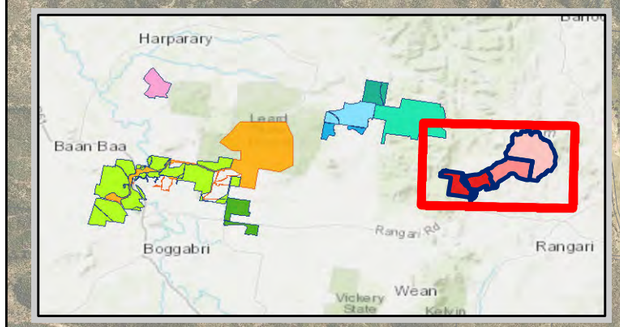
Photo E-1 Existing fencing which requires upgrades at Nioka North

Photo E-2 Existing fencing which requires upgrades at Sunshine

Photo E-3 Existing fencing which requires upgrades at Braefield

Fence line maintenance will be undertaken as required, with issues identified during routine inspections. Redundant interior fencing will be removed over time to reduce the risk of injury to native fauna. At present, no feral animal exclusion fencing is proposed for the Eastern Offsets.

All fencing will be installed and maintained in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document. A schedule for fencing activities within the Eastern Offsets is provided in Table E-54.



Braefield

Sunshine

Nioka North

Legend

Boggabri Project Approval Area

Cadastre

Eastern Offsets

Braefield

Nioka North

Sunshine

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

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REVIEW	N.Cooper
DATE.	10/08/2018

APPENDIX E-33

TITLE. EASTERN OFFSETS

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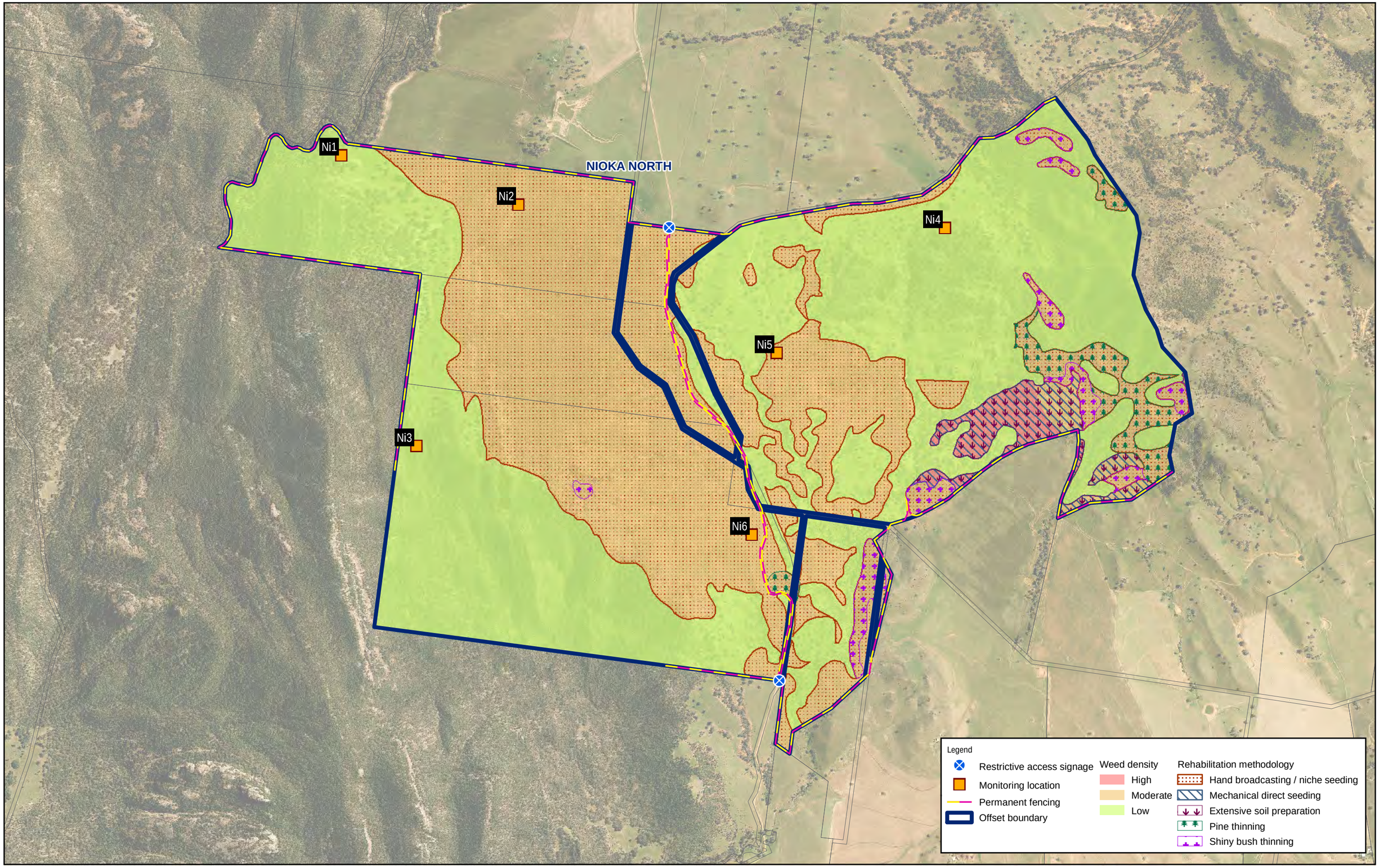

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APPENDIX E-34

TITLE. IMPLEMENTATION MEASURES FOR THE NIOKA NORTH BOA

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SUNSHINE

S1

S2

S3

S4

S5

Legend

Restrictive access signage

Monitoring location

Permanent fencing

Offset boundary

Targeted erosion control

Weed density

High

Moderate

Low

Rehabilitation methodology

Hand broadcasting / niche seeding

Mechanical direct seeding

Extensive soil preparation

Shiny bush thinning

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Coordinate System: GDA 1994 MGA Zone 56
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APPENDIX E-35

TITLE. IMPLEMENTATION MEASURES FOR THE SUNSHINE BOA

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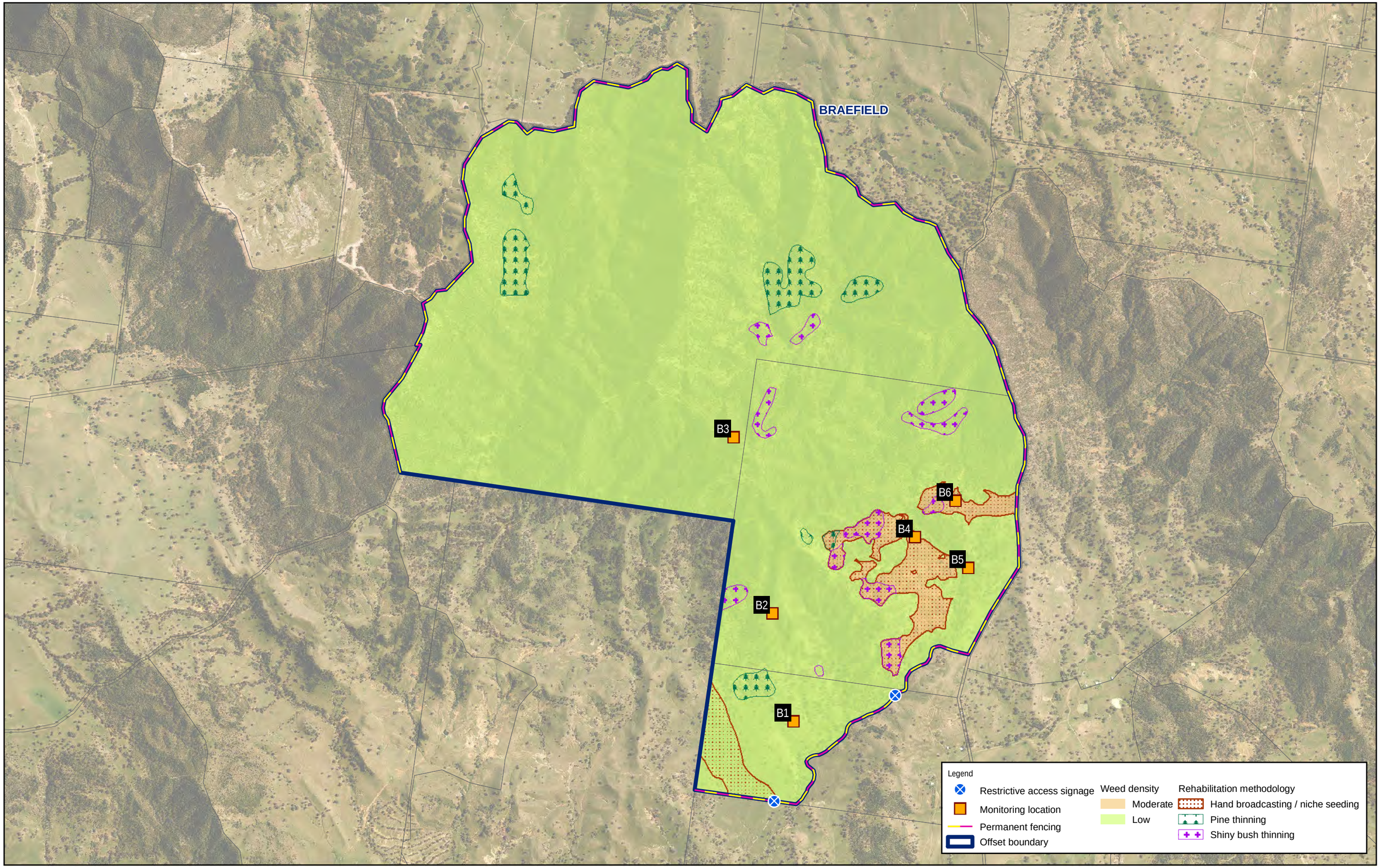

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APPENDIX E-36

TITLE. IMPLEMENTATION MEASURES FOR THE BRAEFIELD BOA

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Table E-54 Eastern Offset target implementation schedule

Implementation measure	Timing	Monitoring frequency	Further information
Fencing			
Construction of permanent fencing	From 2018/2019	Annual	Appendix E Section 2.1.2.1 and Section 6.2.2 of main BMP document.
Maintenance of fence lines, including removal of interior fences	Continuous, as required based on monitoring inspections.	Annual	
Grazing management			
Livestock exclusion	Livestock grazing exclusion to commence once existing leases have expired i.e. Braefield (late 2016) and Nioka North and Sunshine (late 2017). Grazing will be phased out over a 5 year period.	Annual	Appendix E Section 2.1.2.2 and Section 6.2.2 of main BMP document.
Investigation into sustainable livestock carrying capacities and implementation of a seasonal grazing strategy	Continuous, as required based on monitoring inspections. If deemed feasible must be undertaken in accordance with Section 6.2.2.1 of the main BMP document.	Annual	
Weed and pest control			
Broad-scale and targeted weed control in consultation with key stakeholders	Commencement in 2019/2020. Thereafter, continuous as required based on monitoring inspections. To be determined on an annual basis.	Annual	Appendix E Section 2.1.2.3, Appendix C and Section 6.2.2 of main BMP document.
Targeted pest control - destruction of burrows, shooting, trapping and baiting	Continuous, as required based on monitoring inspections.	Annual	
Fire management for conservation			
Engage the Rural Fire Service and communicate the conservation objectives for the Eastern Offsets. Identify fire risks, access points and watering point locations	Commencement of BOA management and as required based on monitoring inspections.	Annual	Appendix E Section 2.1.2.4 and Section 6.2.2 of the main BMP document.
Inspection of fuel loads and assessment of fire requirements	Continuous, as required based on monitoring inspections.	Annual	
Management of human access and disturbance			
Installation of restricted access signs at the designated location	Installation in winter/spring 2016.	Bi-annual	Appendix E Section 2.1.2.5

Implementation measure	Timing	Monitoring frequency	Further information
Maintenance of restricted access signs	Continuous, as required based on monitoring inspections.	Bi-annual	and Section 6.2.2 of the main BMP document.
Maintenance of designated access tracks	Continuous, as required based on monitoring inspections.	Bi-annual	
Retention or addition of habitat features			
Preparation of a nest box procedure	In accordance with criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared five years following commencement of active revegetation.	Annual	Appendix E Section 2.1.2.6, Appendix F and Section 6.2.2 of the main BMP document.
Addition of habitat features	Following yearly tree clearing operations. Addition dependent upon annual habitat feature availability and habitat feature requirements of other BOAs. To be determined on an annual basis.	Annual	
Erosion management			
Identification and assessment of high risk areas	Continuous as required based on monitoring inspections.	Annual and after large storm events	Appendix E Section 2.1.2.7 and Section 6.2.2 of the main BMP document.
Ongoing monitoring and implementation of suitable erosion controls	Implementation of erosion controls in Sunshine and Braefield as identified in Figure E-35 and Figure E-36 at commencement of BOA management. Continuous, as required based on monitoring inspections.	Annual	
Thinning			
Monitor thinning requirements, particularly areas of regenerating White Cypress Pine and Shiny Bush	Continuous, as required based on monitoring inspections.	Bi-annual	Appendix E Section 2.1.2.8 and Section 6.2.2 of the main BMP document.
Implementation of thinning activities	Implementation of thinning as identified in Figure E-34, Figure E-35 and Figure E-36 at commencement of BOA management. Continuous, as required based on monitoring inspections. To be determined on an annual basis.	Bi-annual	
Revegetation			

Implementation measure	Timing	Monitoring frequency	Further information
Site inspection by a suitably qualified person prior to undertaking revegetation works to determine revegetation required such as weed management, seed and tube stock and soil preparation. Update of BMP as required.	After existing leases have expired i.e. grazing excluded. Prior to commencing revegetation works to ensure that the most appropriate measures are being implemented. To be determined an annual basis.	Annual	Appendix E Section 2.1.2.9 and Section 6.2.2 of the main BMP document.
Hand broadcasting/ niche seeding and Mechanical direct seeding and tube stock planting	To be undertaken in 2020-2022 dependent on annual updates to revegetation schedule across all BOAs. Refer to Figure E-32 for preliminary revegetation plan.	Annual	
Follow-up planting, weed control and deep watering	Monitoring and follow up measures to be implemented bi-annually following initial planting / seeding as required based on monitoring inspections.	Bi-annual	

E2.1.2.2 Grazing management for conservation

Livestock grazing exclusion from each of the Eastern Offset BOAs will occur to remove impacts and risks currently associated with the existing grazing regime (Photo E-4 and Photo E-5). Timing for livestock exclusion at each BOA will be as follows:

- Nioka North and Sunshine – from late 2017, livestock grazing will be excluded from all areas classified as Habitat Management Zone and Habitat Restoration Zone (Figure E-34 and Figure E-35).
- Braefield – gradually managed out of the southern portion of Braefield from 2016 and excluded late 2017, livestock grazing will be excluded from the Braefield BOA property (Figure E-36).

Photo E-4 Pasture and weed invasion from livestock grazing

Photo E-5 Livestock grazing damage on steep slopes

Following the establishment of planted vegetation (approximately five years from planting), an investigation will be undertaken to identify sustainable livestock carrying capacities. Based on the results of the investigation, a seasonal grazing strategy may be employed in suitable areas. This will only be undertaken if it is deemed necessary to control weed invasions. Weed invasions within the property is generally low with only a few of the cleared areas containing pasture weed invasions.

The use of livestock for weed control within the Eastern Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.1.2.3 Weed and pest control

Targeted weed and pest control measures will be undertaken as required throughout the Eastern Offsets. Routine inspections will continually monitor the introduction of new weed and pest species and changes to baseline densities, as illustrated in Figure E-34, Figure E-35 and Figure E-36.

Planned weed control activities include a broad-scale control event scheduled for first spring and/or summer following grazing exclusion and every three years after initial treatment or as required against performance criteria and annual monitoring. Targeted weed control to be completed in revegetation areas before each planting/seeding event. Broad-scale control events will be undertaken with reference to the weed density mapping, which will be updated annually as part of the BMP review process.

As part of past agricultural practices the Sunshine BOA has been subjected to large scale aerial seeding of Medicago sp. (Clover) (approx. 5 years ago). In addition all Eastern Offsets properties (Sunshine, Nioka North and Braefield) experience extensive thistle infestations predominately by Mexican Poppy (*Argemone Mexicana**), Saffron Thistle (*Carthamus lanatus**), Variegated Thistle (*Silybum marianum**) and Maltese Thistle (*Centaurea melitensis**). These weeds appear during spring in response to rain and cover a large portion of the grassland areas as previously observed (Photo E-6). It is recommended that these weeds be targeted as part of the weed control measures to ensure correct management of the site for increased biodiversity. Weed incursions within the Eastern Offsets are generally concentrated within cleared areas subject to livestock grazing and along riparian areas.

Photo E-6 Thistle infestation within the Eastern Offsets (2016)

A number of feral pest animals have been recorded throughout the Eastern Offsets including goats, pigs, foxes and rabbits. Goats and pigs are the most abundant and most damaging pests (Photo E-7). The previous owners of Braefield has undertaken targeted 1080 baiting for foxes in conjunction with adjoining property owners in attempts to reduce the abundance of these species. It is recommended that pest control strategies be developed to help control the numbers of these feral animals.

All weed and pest control measures within the Eastern Offsets will be undertaken in accordance with the Weed and Pest Management Strategy (Appendix C) and the overarching management controls detailed in Section 6.2.2 of the main BMP document.

Photo E-7 Damage from feral goats on top of the bluff in the south west of Braefield

E2.1.2.4 Fire management for conservation

No prescribed burning activities are planned within the Eastern Offsets. Fire management within the BOAs will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.1.2.5 Management of human access and disturbance

In order to prevent unauthorised access (e.g. illegal shooting, trail bikes, rubbish dumping) and reduce the risk of introducing or spreading weed and pest species, access gates into the Eastern Offsets will be locked. In 2018, signage will be erected at each of three BOAs to advise unauthorised personnel not to enter. The locations at each BOA are as follows:

- Nioka North – two signs, one at each entry locations, at the north and south of the property boundary (Figure E-34)
- Sunshine – two signs, one at each of the entry locations along the southern boundary of the property (Figure E-35)
- Braefield – two signs, one at each entry location on the southern and eastern boundary of the property (Figure E-36).

Management of human access and disturbance within the Eastern Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.1.2.6 Retention or addition of habitat features

No habitat features, such as fallen timber will be removed from any areas within the Eastern Offsets. Following clearing for mine development or approved thinning activities, habitat features will be transported and strategically placed within the Eastern Offsets. Priority areas to receive habitat features include land within the Eastern Offset's Habitat Restoration Zones.

The removal of Pine trees (*Callitris glaucophylla*) from the Nioka North and Braefield BOAs will remain in the Eastern Offsets. The removed pine will be placed in the Habitat Restoration Zones for fallen timber to provide habitat for reptiles and other ground dwelling fauna.

Rehabilitation activities will be complemented with nest boxes where required to supplement hollows until the rehabilitated areas begin generating. In accordance with the criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared for the Eastern Offsets five years following commencement of active revegetation.

The retention and addition of habitat features within the Eastern Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.1.2.7 Erosion control

No targeted erosion control measures are proposed within the Nioka North property. Such measures will be undertaken as the need is identified during routine environmental inspections. Appropriate erosion control measures may be employed, depending on the nature and extent of future erosion where and when identified.

Targeted erosion control measures are recommended within the Sunshine and Braefield BOAs. There is soil erosion occurring within numerous locations predominately along ephemeral drainage lines (Photo E-8, Photo E-10 and Photo E-9) and require mitigation measures to prevent further damage. These areas are mapped on Figure E-35 and Figure E-36, with a schedule for erosion outlined in Table E-54. One area to the South-East of the Braefield BOA have been subject to contour banks which have aided in reducing impacts associated with erosion (Photo E-10).

Specific erosion and sediment control measures should be implemented for these sites such as terracing or other appropriate sediment and erosion control methods. The majority of the erosion is rill erosion and the rehabilitation of these areas should be undertaken in accordance with the relevant soils and erosion guidelines. The following erosion control measures may be employed, depending on the nature and extent of erosion:

- interceptor banks
- sediment fences
- gabions
- drain and bank stabilisation using geofabrics
- mulching.

Ongoing surveillance for erosion management will target high risk areas, as identified in Figure E-35 and Figure E-36. All erosion control measures will be undertaken in accordance with the overarching management controls detailed in Section 7.2.1.8 of the main BMP document.


Photo E-8 **Rill erosion in an ephemeral drainage line in the north and banks in the south of Sunshine**

Photo E-9 **Rill erosion on the banks of an ephemeral drainage line in the North east of Braefield**

Photo E-10 **Contour banks employed to control erosion in the south west of the property**

E2.1.2.8 Thinning

Pine thinning

White Cypress Pine (*Callitris glaucophylla*) thinning will be undertaken within Nioka North (at three locations) and Braefield (at seven locations). No pine thinning will occur within the Sunshine BOA. In these locations White Cypress Pine have regenerated in dense thickets (Photo E-11) with isolated White Box trees scattered throughout. The scattered White Box trees are likely to respond well to thinning of the White Cypress Pines.

Within the Barefield BOA there are two White Cypress Pine thickets which are located in remote bushland where access to undertake management actions would be difficult given the surrounding terrain. The practicalities of thinning these areas will need to be investigated further, particularly in the North West patches. The remaining areas are all accessible and are recommended for thinning.

In addition to manual and mechanical thinning, Boggabri Coal will investigate and potentially complete trials to assess the potential for controlling White Cypress Pine thickets using low-intensity burns. It is not recommended that low intensity burns be employed in the remote bushland areas of the Braefield BOA to control the pine thickets as the bushland is dense and control of any fire within this area may be difficult.

Thinning activities within the Eastern Offsets will be undertaken in accordance with the overarching management controls detailed in Section 7.2.1.9 of the main BMP document. Densities of White Cypress Pine throughout the property will be monitored, with thinning completed as the need is identified during routine environmental inspections.

Photo E-11 Existing White Cypress Pine requiring thinning

Native shrub management (Shiny Bush)

Targeted control of dense native shrub thickets (consisting of *Dodonea viscosa, Oleria elliptica* and *Beyeria viscosa*) will be undertaken throughout the Eastern Offsets (Photo E-12 and Photo E-13). These areas of have been collectively referred to as “Shiny Bush” and have been mapped on Figure E-34, Figure E-35 and Figure E-36. Routine inspections will continually monitor the introduction of changes to baseline densities.

Photo E-12 Native shrub invasion within Braefield on the lower slopes

Photo E-13 Native shrub invasion within Nioka North

These control measures would be undertaken the same time as the weed and pest control measures. This would involve broad-scale targeted spraying, use of machinery or cut and paste method to thin the densities of the shrubs. These control methods are to be conducted in accordance with the Weed and Pest Management Strategy (Appendix C) and the overarching management controls detailed in Section 6.2.2 of the main BMP document. Broad-scale control events will be undertaken with reference to the native shrub density mapping, which will be updated annually as part of the BMP review process.

E2.1.2.9 Revegetation

Revegetation within the Eastern Offsets will focus on the establishment of Box Gum Grassy Woodland and will be undertaken progressively to increase structural diversity and allow for adaptive management.

The extent, timing and methodologies of revegetation to be employed in the Eastern Offsets will be determined on an annual basis. Prior to commencing revegetation works a site inspection would be undertaken by a suitably qualified person to identify areas which should be targeted and the specific methods required i.e. soil preparation, weed management, thinning and seed/tube stock densities and composition. Revegetation works within the Eastern Offsets will not commence until existing leases have expired (i.e. once grazing has been excluded) as illustrated in the preliminary revegetation plan in Figure E-32 and Table E-54.

Revegetation methods to be employed in the Eastern Offsets will largely include mechanical direct seeding and tube stock planting and hand broadcasting/ niche seeding. Deep ripping and other soil amelioration will be undertaken in targeted areas where required (Figure E-34, Figure E-35 and Figure E-36) to prepare the soil prior to seeding. Seed procurement will be determined after the site inspection and prior to revegetation works based on seed mix attributes provided in Table 6.6 of the main BMP document, availability of seed and in accordance with the current condition and regeneration occurring within the Eastern Offsets (Table E-54).

Fertilising of tube stock will be undertaken at the time of planting by adding 100 g of DAP (di-ammonium phosphate) under the soil surface within 250 mm of the tube stock. Planted tubestock will be watered (approximately 5L/plant) at the time of planting and at least three times within the first year of growth (Table E-54).

The majority of the Braefield BOA (both intact woodland and derived native grasslands) is in good condition and requires less revegetation works than the other two properties. Vegetation condition observed in previous surveys suggests that the soil seed bank is likely to be in good condition. It is recommended that natural revegetation generally be applied to the cleared areas which have been subjected to livestock grazing and areas where White Cypress Pine is thinned.

Routine inspections will be undertaken within revegetation sites to identify plant stress and monitor mortality rates. Areas where high mortality rates are recorded will be revegetated and continually monitored.

E2.1.3 Monitoring and evaluation

Progress against the completion criteria (Section 7.3 of the main BMP document) developed for the Eastern Offsets will be monitored as part of the Biodiversity Monitoring Program described in Section 7.2 of the main BMP document. Seventeen reference sites (nine in habitat management zones, six in habitat restoration zones and two in corridor enhancement zone) will be monitored within the Eastern Offsets, with specific indicators used to compare each site with a corresponding analogue site (Figure E-34, Figure E-35, Figure E-36 and Table E-55).

In addition to these monitoring sites it is proposed that permanent remote cameras are installed in the northern portion of the property where access is difficult. These cameras will have the batteries replaced every 6 months and the data downloaded and viewed in order to capture fauna species which are difficult to record using other methods (i.e. Spotted-tailed Quoll and pest fauna species).

Table E-55 Summary of replicate monitoring sites in the Eastern Offsets

Plant Community Type	Management zone	No. monitoring sites		
		Nioka North	Sunshine	Braefield
River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]	Habitat management zones	-	-	1
Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1119/NA198]		-	1	-
Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1382/NA166]		1	-	-
White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1309/NA226]		-	-	2
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]		1	1	1
Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/NA237]		1	-	-
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226] (low condition)	Habitat restoration zones	3	1	2
Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	Corridor enhancement zone	-	2	-

E2.2 Central Offsets

E2.2.1 Overview

The Central Offsets is comprised of four BOA properties; Mallee, Myall Plains, Wirrilah and Goonbri. These four BOAs are located within the Nandewar Range and form part of the north eastern section of the Regional East-West Wildlife Corridor. Figure E-37 provides an overview of the Central Offsets in a local context.

E2.2.2 Maintenance, enhancement and restoration measures

Figure E-38, Figure E-39 and Figure E-40 illustrate baseline weed densities, monitoring locations, revegetation zones and the proposed layout of permanent fencing and restricted access signage within the Central Offsets. Target implementation measures for the Central Offsets are provided in Table E-56. It is noted that these measures will be amended as required and reviewed at least every twelve months. Specific implementation measures are detailed in the following sections.

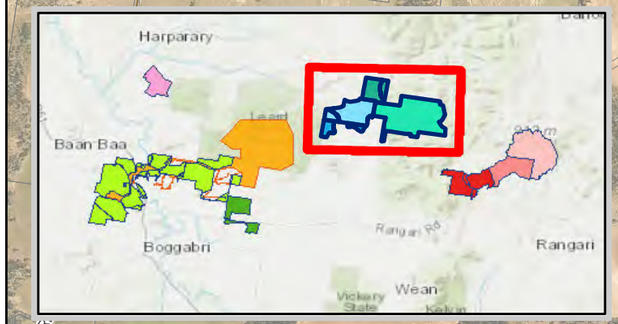
E2.2.2.1 Fencing

The layout of permanent fencing proposed for the Central Offsets is illustrated in Figure E-38, Figure E-39 and Figure E-40. This layout has been developed to exclude livestock from all accessible areas within the property. Existing boundary fencing (Photo E-14) identified in the figures will be replaced or upgraded as required to comply with the overarching management controls for stock exclusion as provided in Section 6.2.2 of the main BMP document.

Photo E-14 Example of existing fencing to be upgraded

Fence line maintenance will be undertaken as required, with issues identified during routine inspections. Redundant interior fencing will be removed over time to reduce the risk of injury to native fauna. At present, no feral animal exclusion fencing is proposed within the Central Offsets.

All fencing will be installed and maintained in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document. A schedule for fencing activities within the Central Offsets is provided in Table E-56.



Myall Plains

Wirrilah

Mallee

Goonbri

GOONBRI ROAD

MALLEE LANE

DRIPPING ROCK ROAD

Legend

Road

Boggabri Project Approval Area

Cadastre

Central Offsets

Goonbri

Mallee

Myall Plains

Wirrilah

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
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DRAWING.	2171706A_GIS_BMP003_A2
AUTHOR.	SuansriR
REVIEW	N.Cooper
DATE.	6/09/2018

APPENDIX E-37

TITLE. CENTRAL OFFSETS

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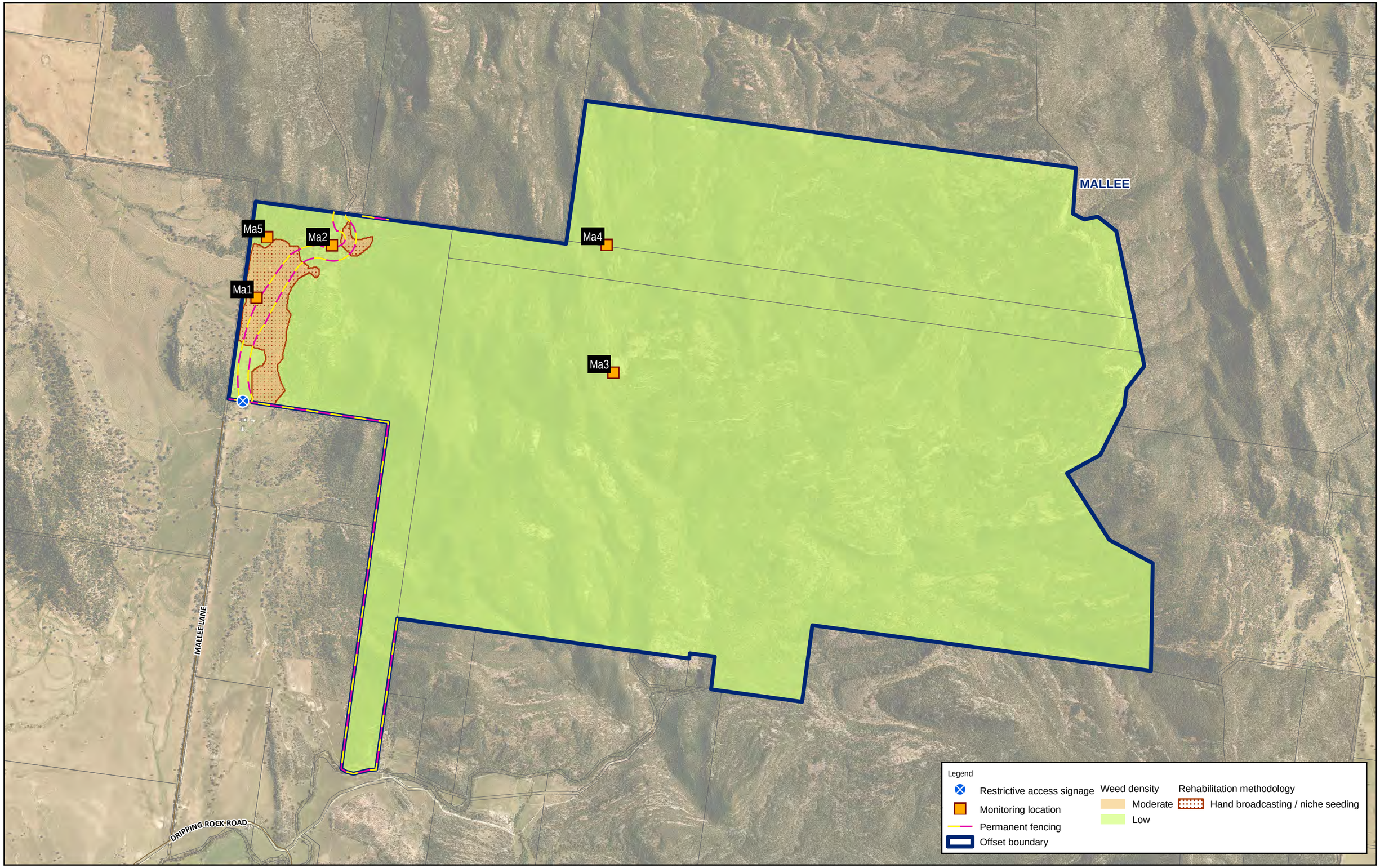

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Coordinate System: GDA 1994 MGA Zone 56
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Imagery:
BCPL (2015) and

MINE NAME.	2171706A_GIS_BMP001_A2
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX E-38

TITLE. IMPLEMENTATION MEASURES FOR THE MALLEE BOA

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MYALL PLAINS

My1

My2

My3

My4

My5

My6

Legend

Restrictive access signage

Monitoring location

Permanent fencing

Offset boundary

Weed density

Moderate

Low

Rehabilitation methodology

Hand broadcasting / niche seeding

Mechanical direct seeding

Extensive soil preparation

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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX E-39

TITLE. IMPLEMENTATION MEASURES FOR THE MYALL PLAINS BOA

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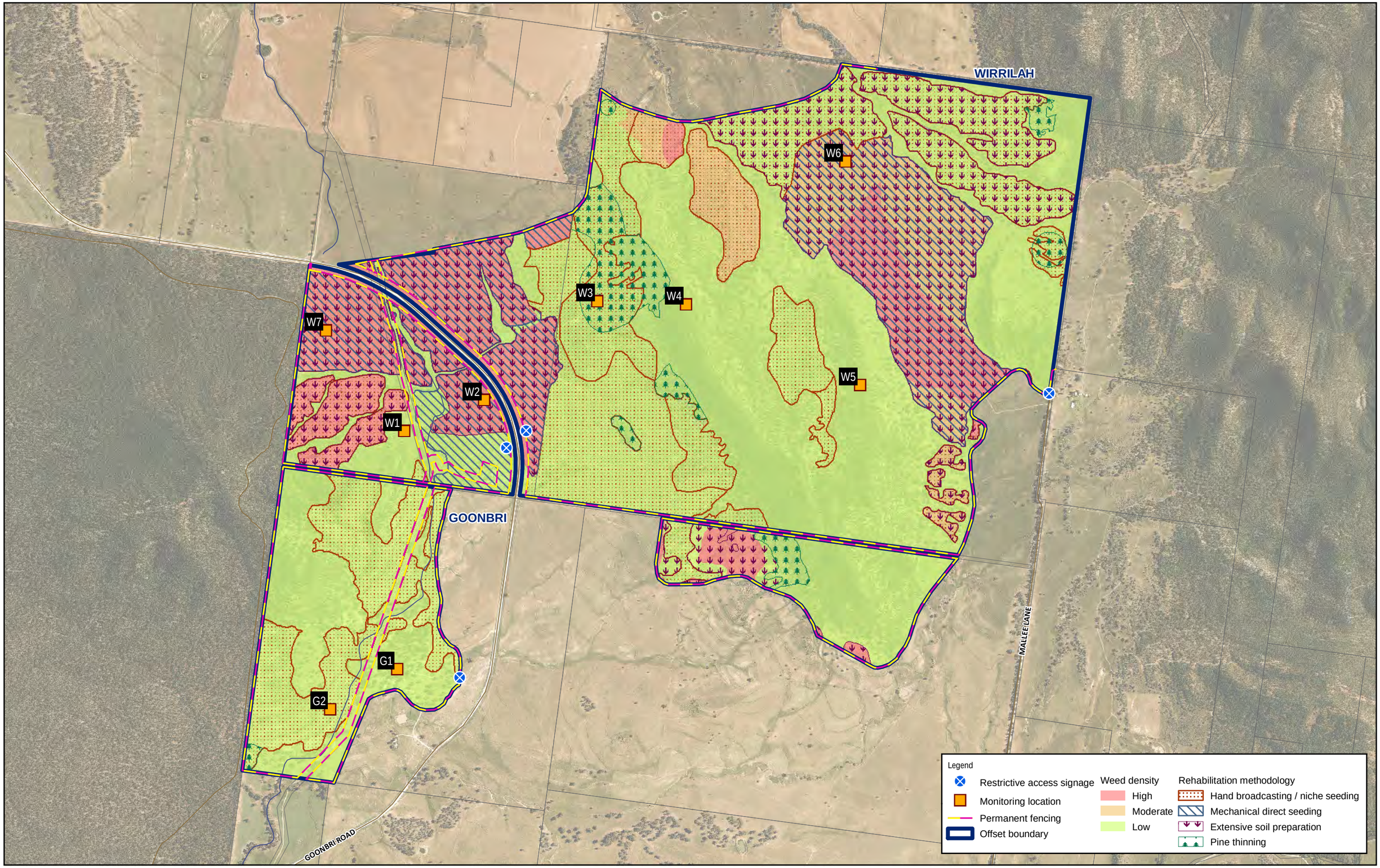

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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX E-40

TITLE. IMPLEMENTATION MEASURES FOR THE WIRRILAH BOA

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Table E-56 Central Offsets target Implementation schedule

Implementation measure	Timing	Monitoring frequency	Further information
Fencing			
Construction of permanent fencing	From 2017 to 2020	Annual	Appendix E Section 2.2.2.1 and Section 6.2.2 of main BMP document.
Maintenance of fence lines, including removal of interior fences	Continuous, as required based on monitoring inspections.	Annual	
Grazing management			
Livestock exclusion	On commencement of management, livestock exclusion to be continued at Mallee BOA. Livestock grazing exclusion to commence in late 2016/early 2017 at Myall Plains and Wirrilah BOAs and phased out over a 5 year period.	Annual	Appendix E Section 2.2.2.2 and Section 6.2.2 of main BMP document.
Investigation into sustainable livestock carrying capacities and implementation of a seasonal grazing strategy	Continuous, as required based on monitoring inspections. If deemed feasible must be undertaken in accordance with Section 7.2.1.2 of the main BMP document.	Annual	
Weed and pest control			
Broad-scale and targeted weed control in consultation with key stakeholders	Commencement in spring/summer 2017. Thereafter, continuous as required based on monitoring inspections. To be determined on an annual basis.	Annual	Appendix E Section 2.2.2.3, Appendix C and Section 6.2.2 of main BMP document.
Targeted pest control - destruction of burrows, shooting, trapping and baiting	Continuous, as required based on monitoring inspections.	Annual	
Fire management for conservation			
Engage the Rural Fire Service and communicate the conservation objectives for the Eastern Offsets. Identify fire risks, access points and watering point locations	Commencement of BOA management and as required based on monitoring inspections.	Annual	Appendix E Section 2.2.2.4 and Section 6.2.2 of the main BMP document.
Inspection of fuel loads and assessment of fire requirements	Continuous, as required based on monitoring inspections.	Annual	
Management of human access and disturbance			
Installation of restricted access signs at the designated location	Installation in winter/spring 2017.	Bi-annual	Appendix E Section 2.2.2.5

Implementation measure	Timing	Monitoring frequency	Further information
Maintenance of restricted access signs	Continuous, as required based on monitoring inspections.	Bi-annual	and Section 6.2.2 of the main BMP document.
Maintenance of designated access tracks	Continuous, as required based on monitoring inspections.	Bi-annual	
Retention or addition of habitat features			
Preparation of a nest box procedure	In accordance with criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared five years following commencement of active revegetation.	Annual	Appendix E Section 2.2.2.6, Appendix F and Section 6.2.2 of the main BMP document.
Addition of habitat features	Following yearly tree clearing operations. Addition dependent upon annual habitat feature availability and habitat feature requirements of other BOAs. To be determined on an annual basis.	Annual	
Erosion management			
Identification and assessment of high risk areas	Continuous as required based on monitoring inspections.	Annual and after large storm events	Appendix E Section 2.2.2.7 and Section 6.2.2 of the main BMP document.
Ongoing monitoring and implementation of suitable erosion controls	Continuous, as required based on monitoring inspections.	Annual	
Thinning			
Monitor thinning requirements, particularly areas of regenerating White Cypress Pine	Continuous, as required based on monitoring inspections.	Bi-annual	Appendix E Section 2.2.2.8 and Section 6.2.2 of the main BMP document.
Implementation of thinning activities	Implementation of thinning as identified in Figure E-38, Figure E-39 and Figure E-40 at commencement of BOA management. Continuous, as required based on monitoring inspections. To be determined on an annual basis.	Bi-annual	
Revegetation			
Site inspection by a suitably qualified person prior to undertaking revegetation works to determine revegetation required such as weed management, seed and tube stock and soil preparation. Update of BMP as required.	Prior to commencing revegetation works to ensure that the most appropriate measures are being implemented. To be determined an annual basis.	Annual	Appendix E Section 2.2.2.9 and Section 6.2.2 of the main BMP document.

Implementation measure	Timing	Monitoring frequency	Further information
Hand broadcasting/ niche seeding and Mechanical direct seeding and tube stock planting	Revegetation to occur as follows: • Wirrilah BOA –2017 all areas requiring revegetation works • Myall Plains, Mallee and Goonbri BOAs - TBD refer to Figure E-32 for preliminary revegetation plan. Timing of and areas to be revegetated will be dependent on annual updates to revegetation schedule across all BOAs.		
Follow-up planting, weed control and deep watering	Monitoring and follow up measures to be implemented bi-annually following initial planting / seeding as required based on monitoring inspections.	Bi-annual	

E2.2.2.2 Grazing management for conservation

Livestock grazing will be excluded within the Central Offsets to remove impacts and risks currently associated with the existing grazing regime (Photo E-15). Livestock exclusion within the Central Offsets will involve:

- Mallee BOA – continued livestock exclusion from the Mallee property.
- Myall Plains, Wirrilah and Goonbri BOAs - exclusion of livestock grazing from all areas classified as Habitat Management Zone, Habitat Restoration Zone and Corridor Enhancement Zone from late 2016.

Following the establishment of planted vegetation (approximately five years from planting) within the Central Offsets (Figure E-38, Figure E-39 and Figure E-40), an investigation will be undertaken to identify sustainable livestock carrying capacities. Based on the results of the investigation, a seasonal grazing strategy may be employed in suitable areas.

The use of livestock for weed control within the Central Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

Photo E-15 Cattle pugging observed in the Wirrilah property

E2.2.2.3 Weed and pest control

Targeted weed and pest control measures will be undertaken as required throughout the Central Offsets. Routine inspections will continually monitor the introduction of new weed and pest species and changes to baseline densities, as illustrated in Figure E-38, Figure E-39 and Figure E-40.

Planned weed control activities include a broad-scale control event scheduled for spring or summer 2017 and targeted spraying or hand-pulling to be completed in revegetation areas before each planting event (Table E-56). Broad-scale control events will be undertaken with reference to the weed density mapping, which will be updated annually as part of the BMP review process.

In some locations within the Central Offsets are subject to extensive infestations of thistles, predominantly Saffron Thistle (*Carthamus lanatus**), Varigated Thistle (*Silybum marianum**)

and Maltese Thistle (*Centaurea melitensis**). These thistles appear during spring in response to rain and cover a large portion of the grassland areas and along access tracks. It is recommended that these weeds be targeted as part of the weed control measures to ensure correct management of the site for increased biodiversity. Weed incursions within the Central Offsets are generally concentrated within cleared areas subject to livestock grazing and along riparian areas.

In spring/ summer 2016, the Environment Superintendent will undertake an investigation to identify the extent of feral goats within the Central Offsets and their impact on biodiversity values. Depending on the outcomes of this investigation, a targeted control plan may be developed and implemented, following the upgrade/ construction of permanent boundary fencing.

All weed and pest control measures within the Central Offsets will be undertaken in accordance with the Weed and Pest Management Strategy (Appendix C) and the overarching management controls detailed in Section 6.2.2 of them aim BMP document.

E2.2.2.4 Fire management for conservation

No prescribed burning activities are planned within the Central Offsets. Fire management within the Central Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 in the main BMP document.

E2.2.2.5 Management of human access and disturbance

In order to prevent unauthorised access (e.g. trail bikes, rubbish dumping) and reduce the risk of introducing or spreading weed and pest species, access gates into the Central Offsets will be locked.

During winter or spring 2016, a restricted access sign will be erected at each of the Central Offset BOAs to advise unauthorised personnel not to enter. The location of restricted access signs will be as follows:

- Malle BOA – single sign at the entrance of the property in the south western boundary of the property (Figure E-38) and access restrictions into the property will additionally be communicated through signage erected as part of management of the Wirrilah and Myall plains properties.
- Myall Plains BOA – two signs, one along the northern boundary of the property and one on the western boundary (Figure E-39) and access restrictions into the property will additionally be communicated by signage erected as part of management of the Wirrilah and Mallee properties.
- Wirrilah BOA – three signs, one sign at the entrance of the property on the eastern boundary, and two at the entrances off Goonbri Road towards the centre of the property (Figure E-40). Access restrictions into the property will additionally be communicated through signage erected as part of management of the Myall Plains and Mallee properties.
- Goonbri – two signs, one along the south western boundary of the property and one at the entrance off Goonbri Road (Figure E-40).

Management of human access and disturbance within the Central Offsets will be undertaken in accordance with the overarching management controls detailed in Section 7.2.1.5 of the main BMP document.

E2.2.2.6 Retention or addition of habitat features

No habitat features, such as fallen timber will be removed from any areas within the Central Offsets. Following clearing for mine development or approved thinning, habitat features will be transported and strategically placed within the Central Offsets.

The addition of habitat features will be prioritised within the Habitat Restoration Zone, Corridor Enhancement Zone and Other Lands for Agriculture Zone within the Central Offsets (Figure E-38, Figure E-39 and Figure E-40).

Rehabilitation activities will be complemented with nest boxes where required to supplement hollows until the rehabilitated areas begin generating. In accordance with the criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared for the Central Offsets five years following commencement of active revegetation.

The retention and addition of habitat features within the Central Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.2.2.7 Erosion control

No targeted erosion control measures are proposed within the Central Offsets. Such measures will be undertaken as the need is identified during routine environmental inspections. The following erosion control measures may be employed, depending on the nature and extent of erosion:

- interceptor banks
- sediment fences
- gabions
- drain and bank stabilisation using geofabrics
- mulching.

Ongoing surveillance will aim to identify high risk areas and areas requiring management intervention, following extreme events, such as flood or fire. All erosion control measures will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 in the main BMP document.

E2.2.2.8 Thinning

Thinning activities will be undertaken within the Wirrilah and Goonbri properties where White Cypress Pine has regenerated in dense thickets (Photo E-16). Densities of White Cypress Pine throughout the property will be monitored, with thinning completed as the need is identified during routine environmental inspections. In addition to manual and mechanical thinning, Boggabri Coal will investigate and potentially complete trials to assess the potential for controlling White Cypress Pine thickets using low-intensity burns.

No thinning activities are planned within the Malle or Myall Plains BOAs. Within these two BOAs densities of White Cypress Pine will be monitored, with thinning completed as the need is identified during routine environmental inspections.

Photo E-16 Existing thickets of White Cypress Pine requiring thinning

Thinning activities within the Central Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.2.2.9 Revegetation

Revegetation within the Central Offsets will focus on the establishment of Box Gum Grassy Woodland and will be undertaken progressively to increase structural diversity and allow for adaptive management.

The extent, timing and methodologies of revegetation to be employed in the Central Offsets will be determined on an annual basis. Prior to commencing revegetation works a site inspection would be undertaken by a suitably qualified person to identify areas which should be targeted and the specific methods required i.e. soil preparation, weed management, thinning and seed/tube stock densities and composition. Revegetation works within the Central Offsets will not commence until existing leases have expired (i.e. once grazing has been excluded) as illustrated in the preliminary revegetation plan in Figure E-32 and Table E-56.

Revegetation methods which will be employed within each of the Central Offsets includes:

- Mallee BOA – hand broadcasting / niche seeding / planting method will be used to revegetate the north-western area of the property (Figure E-38) using a seed mix developed to restore Box Gum Grassy Woodland.
- Myall Plains BOA– hand broadcasting / niche seeding / planting. Deep ripping will be undertaken in targeted areas (Figure E-39) to prepare the soil before seeding.
- Wirrilah BOA – combination of mechanical direct seed and tube stock planting and hand broadcasting / niche seeding / planting. Deep ripping will be undertaken in targeted areas (Figure E-40) to prepare the soil before seeding.
- Goonbri BOA - hand broadcasting / niche seeding / planting. Deep ripping will be undertaken in targeted areas (Figure E-40) to prepare the soil before seeding.

Seed procurement will be determined after the site inspection and prior to revegetation works based on seed mix attributes provided in Table 6.6 of the main BMP document,

availability of seed and in accordance with the current condition and regeneration occurring within the Central Offsets (Table E-54).

Fertilising of tube stock will be undertaken at the time of planting by adding 100 g of DAP (di-ammonium phosphate) under the soil surface within 250 mm of the tube stock. Planted tubestock will be watered (approximately 5L/plant) at the time of planting and at least three times within the first year of growth (Table E-56).

The Wirrilah BOA will be rehabilitated in 2017. A site inspection was undertaken in spring 2016 to determine the current condition and rehabilitation methods which will be required. A summary of the field validated treatment zones identified during the inspection are presented in Figure E-41. Seeding and tube stock mixes are currently being procured for planting in 2017. The treatment zones include:

- A – Large areas where canopy, midstorey and groundcover species generally absent aside from disturb tolerant grasses and regrowth Cassinia and Callitris. Requires:
    - Thistle control
    - Deep ripping of soil prior to planting
    - Tube stock planting (7.5m grid)
    - Direct seeding between tube stock rows.
- B – Small areas which lack a native canopy and midstorey however the groundcover contains native grasses as well as some native herbs and shrubs.
    - Thistle control
    - Deep ripping of soil prior to planting
    - Tube stock planting (7.5m grid)
    - Monitoring of species diversity, regeneration and weeds, modify strategy as required.
- C – Highly disturbed consisting many of exotic species, native limited to the occasional tussock grass species. In very low densities.
    - Thistle control
    - Extensive soil preparation required including deep ripping and soil amelioration as required
    - Tube stock planting (7.5m grid)
    - Direct seeding between tube stock rows.
- D – Minor canopy and groundcover regeneration present however no shrubs occur.
    - Thistle control
    - Monitoring of species diversity, regeneration and weeds, modify strategy as required.
- E – No canopy cover regeneration however sub-canopy and groundcover vegetation showing evidence of regeneration, Callitris clearing required.
    - Thistle control
    - Deep ripping of soil prior to planting
    - Tube stock planting (7.5m grid)
    - Direct seeding between tube stock rows.
    - Callitris thinning required.

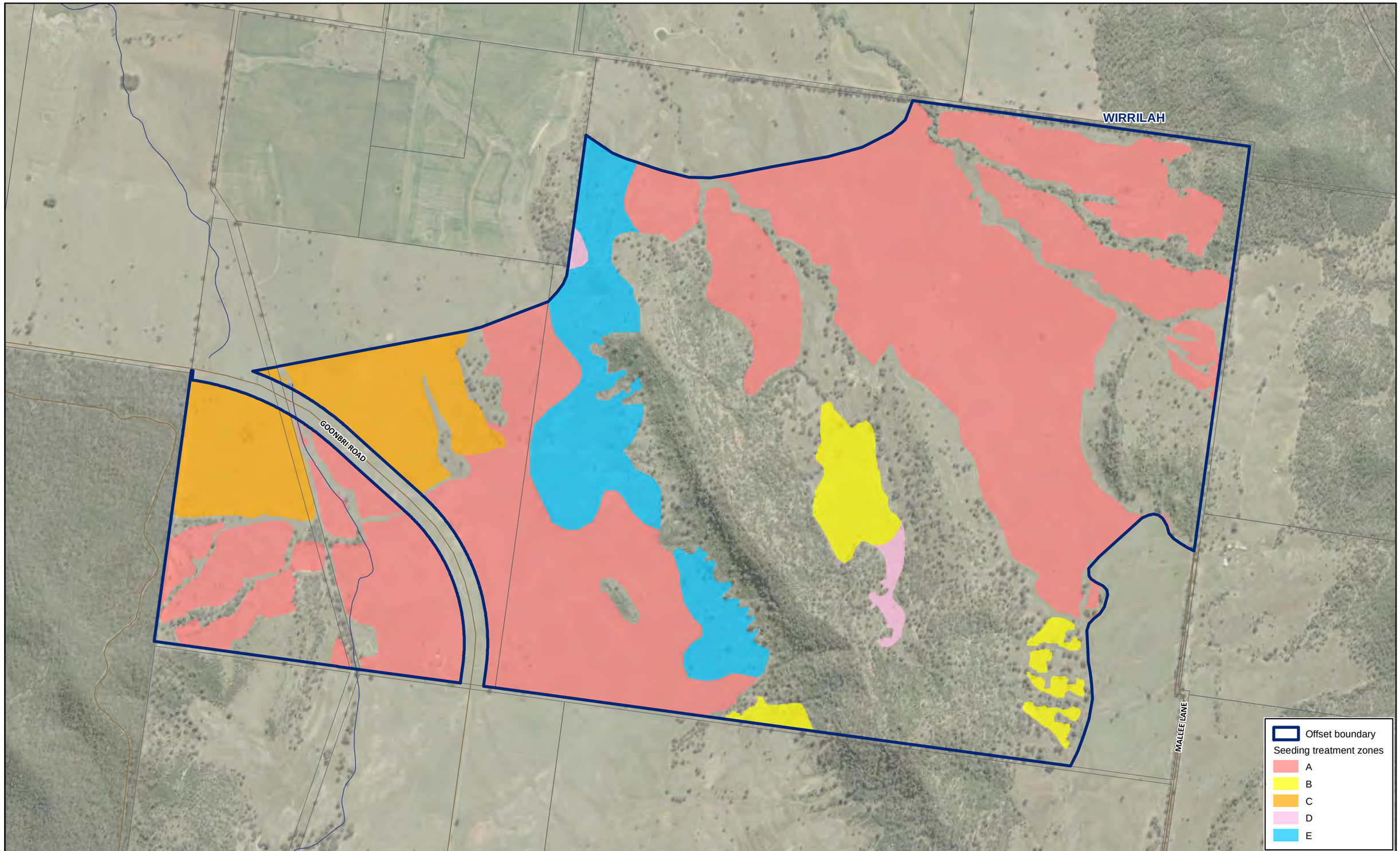
Routine inspections will be undertaken within revegetation sites to identify plant stress and monitor mortality rates. Areas where high mortality rates are recorded will be revegetated and continually monitored.

E2.2.3 Monitoring and evaluation

Progress against the completion criteria developed for the Central Offsets will be monitored as part of the Biodiversity Monitoring Program described in Section 7.2 of the main BMP document. Twenty reference sites (12 in Habitat Management Zones, six in Habitat Restoration Zone and two within Corridor Enhancement Zone) will be monitored within the Central Offsets, with specific indicators used to compare each site with a corresponding analogue site (Figure E-38 to Figure E-40 and Table E-57).

Table E-57 Summary of replicate monitoring sites in the Central Offsets

Plant Community Type	Management zone	No. monitoring sites			
		Mallee	Myall Plains	Wirrilah	Goonbri
Cypress Pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [PCT427/NA410]	Habitat management zone	1	-	-	
White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307_NA224]		-	1	-	
Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1382/NA166]		2	1	-	
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]		-	1	1	
White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]		1	1	2	
Yellow Box – Blakely's Red Gum grassy woodland of the Nandewar Bioregion (PCT1329/NA237)					1
Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1382/NA166] (low condition)	Habitat restoration zone	1	1	-	
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226] (low condition)				2	1
White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228] (low condition)		-	1	-	
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226] (low condition)	Corridor enhancement zone	-	-	2	



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Scale ratio correct when printed at A3

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BIODIVERSITY MANAGEMENT PLAN

Figure E-41
Wirrilah BOA 2016 field validated rehabilitation zones

E2.3 Namoi Offsets

E2.3.1 Overview

The Namoi Offsets consists of the Namoi and Jerralong BOAs. The Namoi BOA is located on the Namoi River floodplain, approximately 1.9 km north-west of the EIS mine disturbance limit (Boggabri Existing). Figure E-42 illustrates the Namoi Offsets in a local context. The Jerralong BOA occurs approximately 2.8 km from the EIS mine disturbance limit (Boggabri Existing) and adjoins to the south-east of the Namoi BOA. The Jerralong BOA represents a section of the Namoi river floodplain that is traversed by Bollol Creek east of its confluence with the Namoi River.

E2.3.2 Maintenance, enhancement and restoration measures

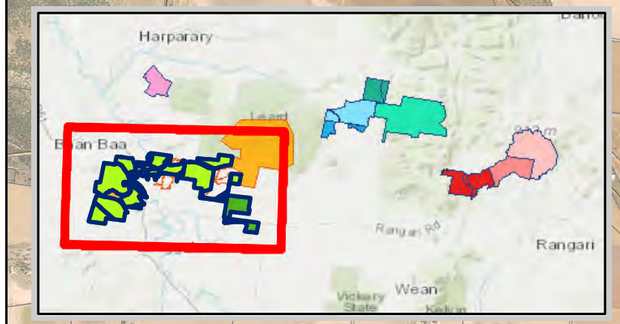
Figure E-43 illustrates baseline weed densities, monitoring locations, revegetation zones and the proposed layout of permanent fencing and restricted access signage. Target implementation measures for the Namoi Offsets are provided in Table E-58. It is noted that these measures will be amended as required and reviewed at least every twelve months. Specific implementation measures are detailed in the following sections.

E2.3.2.1 Fencing

The layout of permanent fencing proposed for the Namoi Offsets is illustrated in Figure E-43. This layout has been developed to exclude livestock from areas within the property and delineate areas based on environmental conditions and conflicting management measures. Existing boundary fencing will be replaced or upgraded to comply with the overarching management controls and minimum fencing design standards provided in Section 6.2.2 of the main BMP document (Photo E-17).

Photo E-17 Existing fencing to be upgraded

Fence line maintenance will be undertaken as required, with issues identified during routine inspections. Redundant interior fencing will be removed over time to reduce the risk of injury to native fauna. At present, no feral animal exclusion fencing is proposed within the Namoi Offsets. All fencing will be installed and maintained in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document. A schedule for fencing activities within the Namoi Offsets is provided in Table E-58.



Namoi

Jerralong

THERRIBRI ROAD

KAMILAROI HIGHWAY

WARINERS ROAD

HEARD FOREST ROAD

GOONBRI ROAD

RANGARI ROAD

BARBERS LAGOON ROAD

CURRACABAH ROAD

CALOOLA ROAD

VINE LANE

BOSTON STREET

BRAYMONT ROAD

Legend

Road

Boggabri Project Approval Area

Cadastre

Namoi Offsets

Jerralong

Namoi

0 250 500 750 1,000 Metres

Scale 1:50,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2015) and Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp.,

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AUTHOR.	SuansriR
REVIEW	N.Cooper
DATE.	6/09/2018

APPENDIX E-42

TITLE. NAMOI OFFSETS

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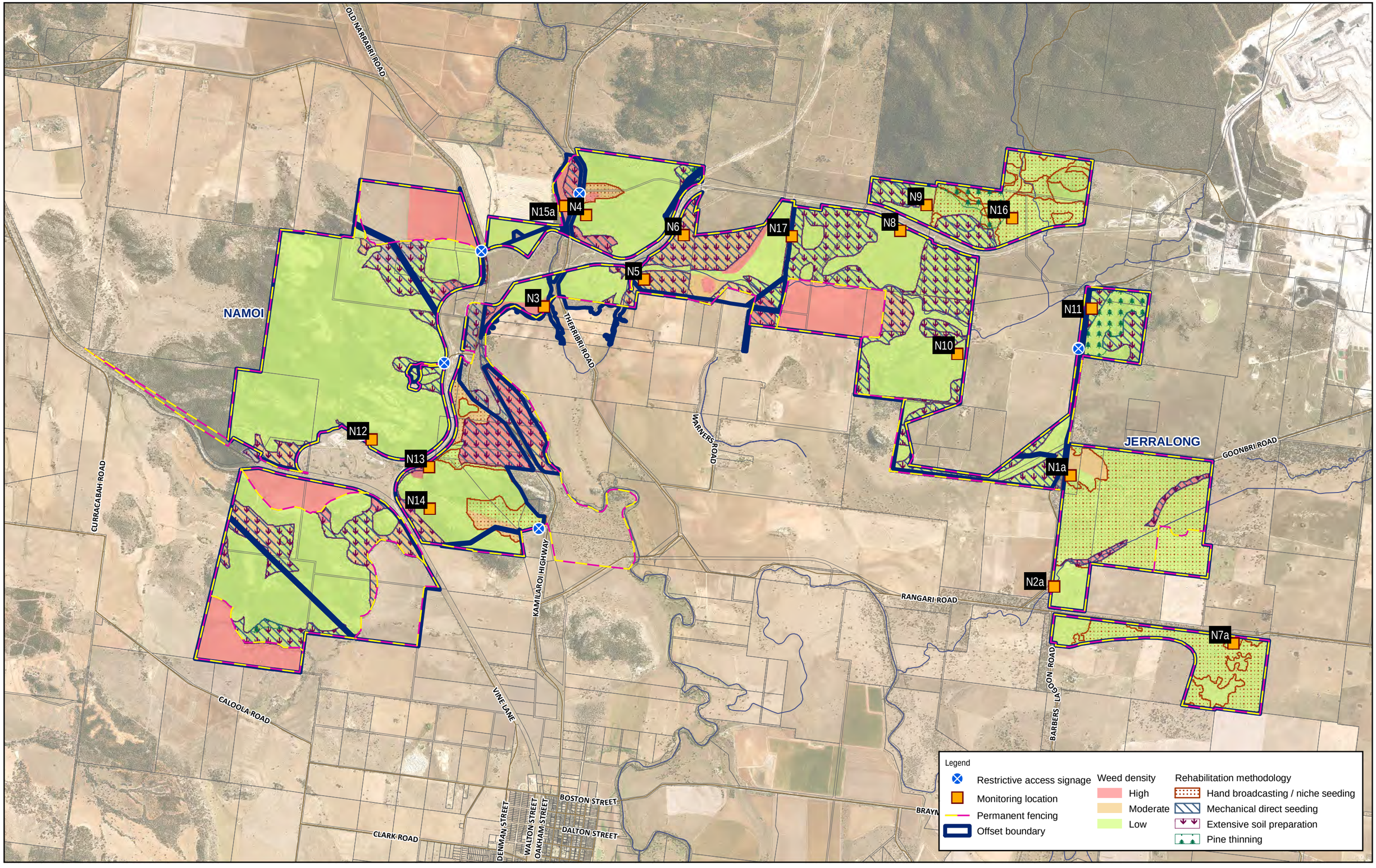

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Imagery:
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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX E-43

TITLE. IMPLEMENTATION MEASURES FOR THE NAMOI BOA

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Table E-58 Namoi Offsets target implementation schedule

Implementation measure	Timing	Monitoring frequency	Further information
Fencing			
Construction of permanent fencing	From late 2017	Annual	Appendix E Section 2.3.2.1 and Section 6.2.2 of main BMP document.
Maintenance of fence lines, including removal of interior fences	Continuous, as required based on monitoring inspections.	Annual	
Grazing management			
Livestock exclusion	Livestock grazing exclusion to commence in late 2015 / early 2016 and phased out over a 5 year period. Livestock grazing exclusion in the Jerralong BOA to commence in late 2018 and phased out over a f year period.	Annual	Appendix E Section 2.3.2.2 and Section 6.2.2 of main BMP document.
Investigation into sustainable livestock carrying capacities and implementation of a seasonal grazing strategy	Continuous, as required based on monitoring inspections. If deemed feasible must be undertaken in accordance with Section 6.2.2of the main BMP document.	Annual	
Weed and pest control			
Broad-scale and targeted weed control in consultation with key stakeholders	Commencement in 2017/18. Thereafter, continuous as required based on monitoring inspections. To be determined on an annual basis.	Annual	Appendix E Section 2.3.2.3, Appendix C and Section 6.2.2 of main BMP document.
Targeted pest control - destruction of burrows, shooting, trapping and baiting	Continuous, as required based on monitoring inspections.	Annual	
Fire management for conservation			
Engage the Rural Fire Service and communicate the conservation objectives for the Eastern Offsets. Identify fire risks, access points and watering point locations	Commencement of BOA management and as required based on monitoring inspections.	Annual	Appendix E Section 2.3.2.4 and Section 6.2.2 of the main BMP document.
Inspection of fuel loads and assessment of fire requirements	Continuous, as required based on monitoring inspections.	Annual	
Management of human access and disturbance			

Implementation measure	Timing	Monitoring frequency	Further information
Installation of restricted access signs at the designated location	Installation in winter/spring 2016.	Bi-annual	Appendix E Section 2.3.2.5 and Section 6.2.2 of the main BMP document.
Maintenance of restricted access signs	Continuous, as required based on monitoring inspections.	Bi-annual	
Maintenance of designated access tracks	Continuous, as required based on monitoring inspections.	Bi-annual	
Retention or addition of habitat features			
Preparation of a nest box procedure	In accordance with criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared five years following commencement of active revegetation.	Annual	Appendix E Section 2.3.2.6, Appendix F and Section 6.2.2 of the main BMP document.
Addition of habitat features	Following yearly tree clearing operations. Addition dependent upon annual habitat feature availability and habitat feature requirements of other BOAs. To be determined on an annual basis.	Annual	
Erosion management			
Identification and assessment of high risk areas	Continuous as required based on monitoring inspections.	Annual and after large storm events	Appendix E Section 2.3.2.7 and Section 6.2.2 of the main BMP document.
Ongoing monitoring and implementation of suitable erosion controls	Implementation of erosion controls along Namoi River to be implemented in spring/summer 2018/2019. Continuous, as required based on monitoring inspections.	Annual	
Thinning			
Monitor thinning requirements, particularly areas of regenerating White Cypress Pine	Continuous, as required based on monitoring inspections.	Bi-annual	Appendix E Section 2.3.2.8 and Section 6.2.2 of the main BMP document.
Implementation of thinning activities	Implementation of thinning as identified in Figure E-43 at commencement of BOA management. Continuous, as required based on monitoring inspections. To be determined on an annual basis.	Bi-annual	
Revegetation			

Implementation measure	Timing	Monitoring frequency	Further information
Site inspection by a suitably qualified person prior to undertaking revegetation works to determine revegetation required such as weed management, seed and tube stock and soil preparation. Update of BMP as required.	Prior to commencing revegetation works to ensure that the most appropriate measures are being implemented. To be determined an annual basis.	Annual	Appendix E Section 2.3.2.9 and Section 6.2.2 of the main BMP document.
Hand broadcasting/ niche seeding	To be undertaken in spring/summer 2017 - 2023 dependent on annual updates to revegetation schedule across all BOAs.		
Follow-up planting, weed control and deep watering	Monitoring and follow up measures to be implemented bi-annually following initial planting / seeding as required based on monitoring inspections.	Bi-annual	

E2.3.2.2 Grazing management for conservation

From late 2017, livestock grazing will be excluded from all areas classified as Habitat Management Zone, Habitat Restoration Zone and Corridor Enhancement Zone (Figure E-25). Following the establishment of planted vegetation (approximately five years from planting), an investigation will be undertaken to identify sustainable livestock carrying capacities. Based on the results of the investigation, a seasonal grazing strategy may be employed in suitable areas.

The use of livestock for weed control within the Namoi Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.3.2.3 Weed and pest control

Targeted weed and pest control measures will be undertaken as required throughout the Namoi Offsets. Routine inspections will continually monitor the introduction of new weed and pest species and changes to baseline densities, as illustrated in Figure E-43.

Planned weed control activities include a broad-scale control event scheduled for spring or summer 2017 and targeted spraying or hand-pulling to be completed in revegetation areas before each planting event (Table E-58). Broad-scale control events will be undertaken with reference to the weed density mapping, which will be updated annually as part of the BMP review process.

In some locations within the Namoi Offsets are subject to extensive infestations of thistles, predominantly Saffron Thistle (*Carthamus lanatus**), Variegated Thistle (*Silybum marianum**) and Maltese Thistle (*Centaurea melitensis**). These thistles appear during spring in response to rain and cover a large portion of the grassland areas and along access tracks. It is recommended that these weeds be targeted as part of the weed control measures to ensure correct management of the site for increased biodiversity. Weed incursions within the Namoi Offsets are generally concentrated within cleared areas subject to livestock grazing and along riparian areas. Areas within the Namoi Offsets contain noxious woody weeds such as African Boxthorn (*Lycium ferocissimum**) which should alsio be targeted during control events.

In spring / summer 2016, the Environment Superintendent will undertake an investigation to identify the extent of feral animals throughout the Namoi Offsets and their impact on biodiversity values. Following this investigation a targeted control plan will be developed and implemented, following the upgrade/ construction of permanent boundary fencing.

Photo E-18 Feral goats observed in the Namoi Offsets

All weed and pest control measures within the Namoi Offsets will be undertaken in accordance with the Weed and Pest Management Strategy (Appendix C) and the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.3.2.4 Fire management for conservation

No prescribed burning activities are planned within the Namoi Offsets. Fire management within the BOAs will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.3.2.5 Management of human access and disturbance

In order to prevent unauthorised access (e.g. trail bikes, rubbish dumping) and reduce the risk of introducing or spreading weed and pest species, access gates into the Namoi Offsets will be locked. During winter or spring 2016, signs will be erected at five locations to advise unauthorised personnel not to enter (Figure E-43 and Table E-58).

Management of human access and disturbance within the Namoi Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.3.2.6 Retention or addition of habitat features

No habitat features, such as fallen timber will be removed from any areas within the Namoi Offsets. Following clearing for mine development or approved thinning, habitat features will be transported and strategically placed within the Namoi Offsets. Priority areas to receive habitat features include land within the Corridor Enhancement and Habitat Restoration Zones.

Rehabilitation activities will be complemented with nest boxes where required to supplement hollows until the rehabilitated areas begin generating. In accordance with the criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared for the Namoi Offsets five years following commencement of active revegetation.

The retention and addition of habitat features within the Namoi Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.3.2.7 Erosion control

The Namoi Offsets contains areas of significant erosion, particularly along the Namoi River, which was impacted by a major flood event in early 2012 (Photo E-19).

Photo E-19 Erosion along the banks of Namoi River

In spring/summer 2017, the Environment Superintendent will consult with the Namoi CMA to identify appropriate measures to manage existing erosion and mitigate the impacts of future flooding events.

Ongoing surveillance for erosion management will target high risk areas, as identified in Figure E-43. All erosion control measures will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.3.2.8 Thinning

Thinning will be undertaken at four locations in the Namoi Offsets where White Cypress Pine has regenerated in dense thickets (Photo E-20).

Photo E-20 Existing thickets of White Cypress Pine requiring thinning

In addition to manual thinning, Boggabri Coal will investigate and potentially complete trials to assess the potential for controlling White Cypress Pine thickets using low-intensity burns. Thinning activities within the Namoi Offsets will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document. Densities of White Cypress Pine throughout the property will be monitored, with thinning completed as the need is identified during routine environmental inspections.

E2.3.2.9 Revegetation

Revegetation within the Namoi Offsets will focus on the establishment of the following four communities:

- Grassy Box Gum Woodland
- River Red Gum
- Poplar Box woodland
- Ironbark Shrubby Forest.

Revegetation will be undertaken progressively to increase structural diversity and allow for adaptive management. The extent, timing and methodologies of revegetation to be employed in the Namoi Offsets will be determined on an annual basis. Prior to commencing revegetation works a site inspection would be undertaken by a suitably qualified person to identify areas which should be targeted and the specific methods required i.e. soil preparation, weed management, thinning and seed/tube stock densities and composition. A preliminary revegetation plan is provided in Figure E-32 and Table E-58.

Revegetation methods to be employed in the Namoi Offsets will largely include mechanical direct seed and tube stock planting and hand broadcasting/ niche seeding. Deep ripping and other soil amelioration will be undertaken in targeted areas (Figure E-43) to prepare the soil prior to seeding. Jerralong propert will largely include mechanical direct seed and tube stock planting and hand broadcasting/ niche seeding. Seed procurement will be determined after the site inspection and prior to revegetation works based on seed mix attributes provided in Table 6.6 of the main BMP document, availability of seed and in accordance with the current condition and regeneration occurring within the Namoi Offsets (Table E-54).

A portion of the Namoi BOA will be rehabilitated in 2016/2017. A site inspection was undertaken in spring 2016 to determine the current condition and rehabilitation methods which will be required. A summary of the field validated treatment zones identified during the inspection are presented in Figure E-44. Seeding and tube stock mixes are currently being procured for planting in 2016/2017. The treatment zones include:

- A – Large areas where canopy, midstorey and groundcover species generally absent aside from disturb tolerant grasses and regrowth Cassinia and Callitris. Requires:
  - Thistle control
  - Deep ripping of soil prior to planting
  - Tube stock planting (7.5m grid)
  - Direct seeding between tube stock rows.
- B – Small areas which lack a native canopy and midstorey however the groundcover contains native grasses as well as some native herbs and shrubs.
  - Thistle control
  - Deep ripping of soil prior to planting
  - Tube stock planting (7.5m grid)
  - Monitoring of species diversity, regeneration and weeds, modify strategy as required.
- C – Highly disturbed consisting many of exotic species, native limited to the occasional tussock grass species. In very low densities.
  - Thistle control
  - Extensive soil preparation required including deep ripping and soil amelioration as required
  - Tube stock planting (7.5m grid)
  - Direct seeding between tube stock rows.
- D – Minor canopy and groundcover regeneration present however no shrubs occur.
  - Thistle control
  - Monitoring of species diversity, regeneration and weeds, modify strategy as required.
- E – No canopy cover regeneration however sub-canopy and groundcover vegetation showing evidence of regeneration, Callitris clearing required.
  - Thistle control
  - Deep ripping of soil prior to planting
  - Tube stock planting (7.5m grid)
  - Direct seeding between tube stock rows.
  - Callitris thinning required.
- F – Canopy species present however midstorey absent and groundcover species limited.
  - Thistle control
  - Niche seeding
  - Callitris thinning required.
- G – Regeneration appears to be evident in all stratum, Callitris thinning as required.
  - Monitor species diversity, regeneration and weeds, modify strategy as required.

Fertilising of tube stock will be undertaken at the time of planting by adding 100 g of DAP (di-ammonium phosphate) under the soil surface within 250 mm of the tube stock. Planted

tubestock will be watered (approximately 5L/plant) at the time of planting and at least three times within the first year of growth (Table E-58).

Routine inspections will be undertaken within revegetation sites to identify plant stress and monitor mortality rates. Areas where high mortality rates are recorded will be revegetated and continually monitored.

E2.3.3 Monitoring and evaluation

Progress against the completion criteria developed for the Namoi Offsets will be monitored as part of the Biodiversity Monitoring Program described in Section 7.2 of the main BMP document. Seventeen reference sites (11 in habitat management zones and six in Habitat Restoration Zones) will be monitored within the Namoi Offsets, with specific indicators used to compare each site with a corresponding analogue site (Figure E-44 and Table E-59).

Table E-59 Summary of monitoring sites on the Namoi Offsets

Vegetation community	Management zone	No. monitoring sites	
		Namoi	Jerralong
Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]	Habitat management zone	1	
White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]		1	1
Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / BVT NA 179)		1	2
River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 78 / BVT NA 193)		2	
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (PCT 27 / BVT NA 219)		1	
River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions (PCT 84 / BVT NA 191)		1	
Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (PCT 1381 / BVT NA 165)		2	
Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / BVT NA 179) (Low condition)	Habitat restoration zone	2	
River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 78 / BVT NA 193) (low condition)		1	
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 1383 / BVT NA 226) (low condition)		2	

NAMOI

Offset boundary

Seeding treatment zones

A

C

E

F

G

Map: 2171706A_GIS_BMP012_A1	Author: SuansriR	0 130 260 Meters	BIODIVERSITY MANAGEMENT PLAN
Date: 5/10/2017	Approved by: - BangelT	1:10,000	Figure E-44 Namoi BOA 2016 field validated rehabilitation zones

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
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Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

E2.4 Western Offsets

E2.4.1 Overview

The Western Offset consists of the Merriendi BOA. The Western Offset is located approximately 8.3 km north-west of the EIS mine disturbance limit (Boggabri Existing) and immediately west of the Leard State Conservation Area. Figure E-45 illustrates the Western Offset in a local context.

E2.4.2 Maintenance, enhancement and restoration measures

Figure E-46 illustrates baseline weed densities, monitoring locations, revegetation zones and the proposed layout of permanent fencing and restricted access signage. Target implementation measures for the Western Offset is provided in Table E-60. It is noted that these measures will be amended as required and reviewed at least every twelve months. Specific implementation measures are detailed in the following sections.

E2.4.2.1 Fencing

The layout of permanent fencing proposed for the Western Offset is illustrated in Figure E-46. This layout has been developed to exclude livestock from areas within the property and delineate areas based on environmental conditions and conflicting management measures.

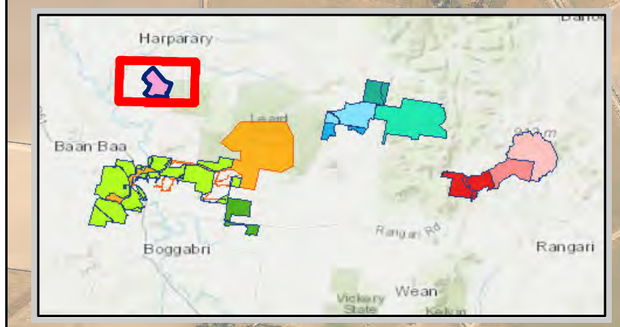
Redundant interior fencing will be removed over time to reduce the risk of injury to native fauna. Fence line maintenance will be undertaken as required, with issues identified during routine inspections. At present, no feral animal exclusion fencing is proposed within the Western Offset.

All fencing will be installed and maintained in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document. A schedule for fencing activities within the Merriendi property is provided in Table E-60.

E2.4.2.2 Grazing management for conservation

All livestock will be excluded from the property from late 2015. Following the establishment of planted vegetation (approximately five years from planting), an investigation will be undertaken to identify sustainable livestock carrying capacities. Based on the results of the investigation, a seasonal grazing strategy may be employed in suitable areas.

The use of livestock for weed control within the Western Offset will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.



TRANTHAM ROAD

THERRIBRI ROAD

Merriendi

HARPARARY

Legend
- Road
- Boggabri Project Approval Area
- Cadastre

Western Offsets
- Merriendi

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Scale 1:17,500

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2015) and Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp.,

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AUTHOR.	SuansriR
REVIEW	N.Cooper
DATE.	6/09/2018

APPENDIX E-45

WESTERN OFFSET - MERRIENDI BOA

TITLE.

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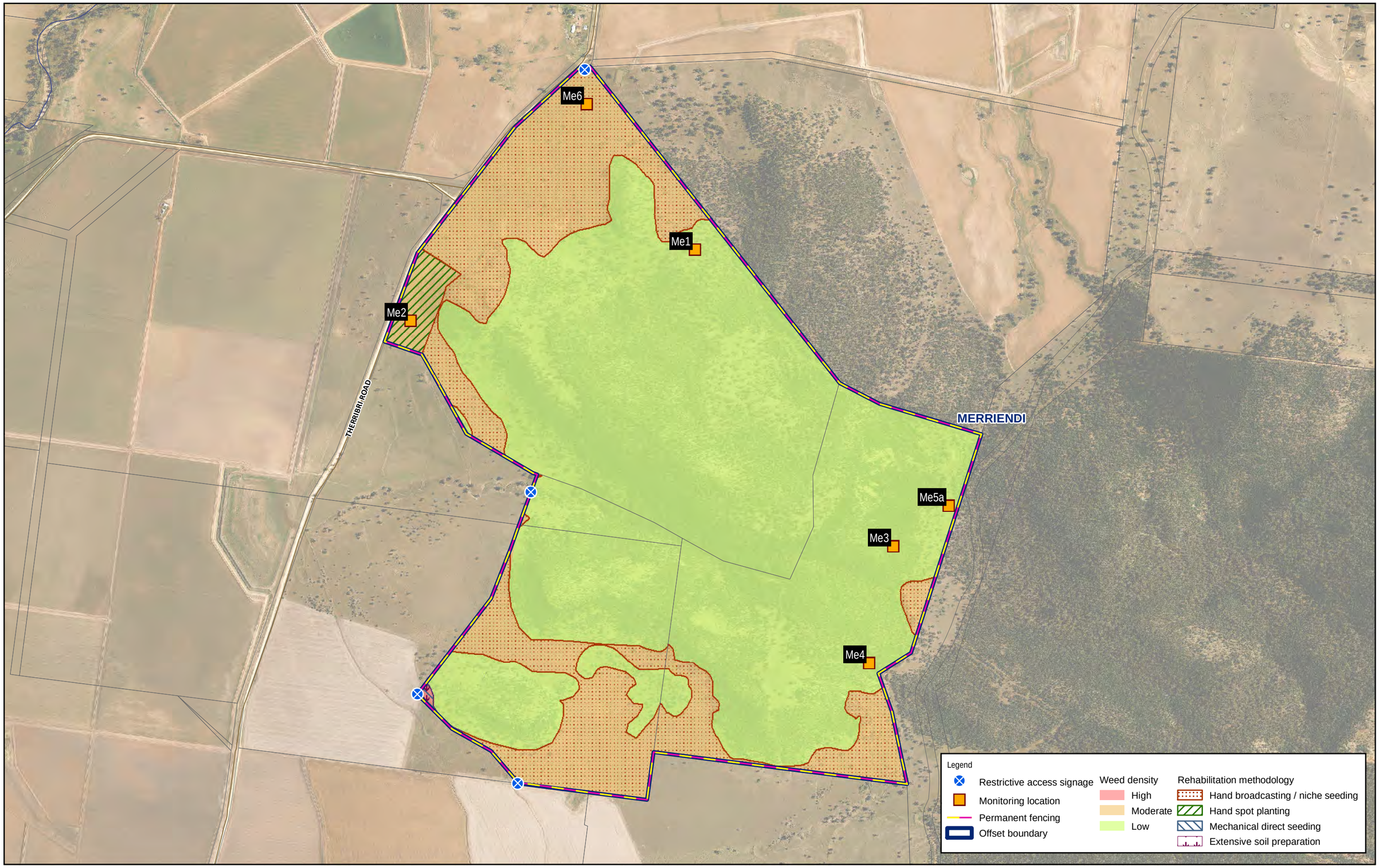

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MINE NAME.	2171706A_GIS_BMP001_A2
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX E-46

TITLE. IMPLEMENTATION MEASURES FOR THE MERRIENDI BOA

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Table E-60 Western Offset target implementation schedule

Implementation measure	Timing	Monitoring frequency	Further information
Fencing			
Construction of permanent fencing	From 2019 to 2020.	Annual	Appendix E Section 2.4.2.1 and Section 6.2.2 of main BMP document.
Maintenance of fence lines, including removal of interior fences	Continuous, as required based on monitoring inspections.	Annual	
Grazing management			
Livestock exclusion	Livestock grazing exclusion to commence in late 2015 / early 2016 and phased out over a 5 year period.	Annual	Appendix E Section 2.4.2.2 and Section 6.2.2 of main BMP document.
Investigation into sustainable livestock carrying capacities and implementation of a seasonal grazing strategy	Continuous, as required based on monitoring inspections. If deemed feasible must be undertaken in accordance with Section 6.2.2 of the main BMP document.	Annual	
Weed and pest control			
Broad-scale and targeted weed control in consultation with key stakeholders	Commencement in spring/summer 2016/17. Thereafter, continuous as required based on monitoring inspections. To be determined on an annual basis.	Annual	Appendix E Section 2.4.2.3, Appendix C and Section 6.2.2 of main BMP document.
Targeted pest control - destruction of burrows, shooting, trapping and baiting	Continuous, as required based on monitoring inspections.	Annual	
Fire management for conservation			
Engage the Rural Fire Service and communicate the conservation objectives for the Eastern Offsets. Identify fire risks, access points and watering point locations	Commencement of BOA management and as required based on monitoring inspections.	Annual	Appendix E Section 2.4.2.4 and Section 6.2.2 of the main BMP document.
Inspection of fuel loads and assessment of fire requirements	Continuous, as required based on monitoring inspections.	Annual	
Management of human access and disturbance			
Installation of restricted access signs at the designated location	Installation in winter/spring 2016.	Bi-annual	Appendix E Section 2.4.2.5 and Section 6.2.2
Maintenance of restricted access signs	Continuous, as required based on monitoring inspections.	Bi-annual	

Implementation measure	Timing	Monitoring frequency	Further information
Maintenance of designated access tracks	Continuous, as required based on monitoring inspections.	Bi-annual	of the main BMP document.
Retention or addition of habitat features			
Preparation of a nest box procedure	In accordance with criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared five years following commencement of active revegetation.	Annual	Appendix E Section 2.4.2.6, Appendix F and Section 6.2.2 of the main BMP document.
Addition of habitat features	Following yearly tree clearing operations. Addition dependent upon annual habitat feature availability and habitat feature requirements of other BOAs. To be determined on an annual basis.	Annual	
Erosion management			
Identification and assessment of high risk areas	Continuous as required based on monitoring inspections.	Annual and after large storm events	Appendix E Section 2.4.2.7 and Section 6.2.2 of the main BMP document.
Ongoing monitoring and implementation of suitable erosion controls	Continuous, as required based on monitoring inspections.	Annual	
Thinning			
Monitor thinning requirements, particularly areas of regenerating White Cypress Pine and Shiny Bush	Continuous, as required based on monitoring inspections.	Bi-annual	Appendix E Section 2.4.2.8 and Section 6.2.2 of the main BMP document.
Implementation of thinning activities	Continuous, as required based on monitoring inspections.	Bi-annual	
Revegetation			
Site inspection by a suitably qualified person prior to undertaking revegetation works to determine revegetation required such as weed management, seed and tube stock and soil preparation. Update of BMP as required.	Prior to commencing revegetation works to ensure that the most appropriate measures are being implemented. To be determined an annual basis.	Annual	Appendix E Section 2.4.2.9 and Section 6.2.2

Implementation measure	Timing	Monitoring frequency	Further information
Hand broadcasting/ niche seeding	To be undertaken in 2021-2022 dependent on annual updates to revegetation schedule across all BOAs.		of the main BMP document.
Follow-up planting, weed control and deep watering	Monitoring and follow up measures to be implemented bi-annually following initial planting / seeding as required based on monitoring inspections.	Bi-annual	

E2.4.2.1 Weed and pest control

Targeted weed and pest control measures will be undertaken as required throughout the Western Offset. Routine inspections will continually monitor the introduction of new weed and pest species and changes to baseline densities, as illustrated in Figure E-46.

Planned weed control activities include a broad-scale control event scheduled for spring or summer 2016 and targeted spraying or hand-pulling to be completed in revegetation areas before each planting event (Table E-60). Broad-scale control events will be undertaken with reference to the weed density mapping, which will be updated annually as part of the BMP review process.

Some locations within the Western Offset are subject to extensive infestations of thistles, predominantly Saffron Thistle (*Carthamus lanatus**), Variegated Thistle (*Silybum marianum**) and Maltese Thistle (*Centaurea melitensis**). These thistles appear during spring in response to rain and cover a large portion of the grassland areas and along access tracks. It is recommended that these weeds be targeted as part of the weed control measures to ensure correct management of the site for increased biodiversity. Weed incursions within the Western Offset are generally concentrated within cleared areas subject to livestock grazing and along riparian areas.

All weed and pest control measures within the Western Offset will be undertaken in accordance with the Weed and Pest Management Strategy (Appendix C) and the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.4.2.2 Fire management for conservation

No prescribed burning activities are planned within the Merriendi property. Fire management within the BOAs will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.4.2.3 Management of human access and disturbance

In order to prevent unauthorised access (e.g. trail bikes, rubbish dumping) and reduce the risk of introducing or spreading weed and pest species, access gates into the Western Offset will be locked. In 2018, signs will be erected at three locations to advise unauthorised personnel not to enter (Figure E-46 and Table E-60).

Management of human access and disturbance within the Western Offset will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.4.2.4 Retention or addition of habitat features

No habitat features, such as fallen timber will be removed from any areas within the Western Offset. Following clearing for mine development or approved thinning, habitat features will be transported and strategically placed within the Western Offset. Priority areas to receive habitat features include revegetation areas within the Other Lands for Agriculture Zone and clearings within Habitat Restoration Zones. The placement of habitat features will avoid areas where the threatened plant *Digitaria porrecta* has been recorded (Figure E-30).

Rehabilitation activities will be complemented with nest boxes where required to supplement hollows until the rehabilitated areas begin generating. In accordance with the criteria detailed in Section 6.2.2 and Section 7.3 of the main BMP document and threatened biodiversity implementation plan (Appendix F), a nest box procedure will be prepared for the Western Offset five years following commencement of active revegetation.

The retention and addition of habitat features within the Western Offset will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.4.2.5 Erosion control

No targeted erosion control measures are proposed within the Western Offset. Such measures will be undertaken as the need is identified during routine environmental inspections. The following erosion control measures may be employed, depending on the nature and extent of erosion:

- interceptor banks
- sediment fences
- gabions
- drain and bank stabilisation using geofabrics
- mulching.

Ongoing surveillance for erosion management will target high risk areas, as identified in Figure E-46. All erosion control measures will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2 of the main BMP document.

E2.4.2.6 Thinning

No thinning activities are planned within the Western Offset. Densities of White Cypress Pine will be monitored, with thinning completed as the need is identified during routine environmental inspections.

Thinning activities within the Western Offset will be undertaken in accordance with the overarching management controls detailed in Section 6.2.2of the main BMP document.

E2.4.2.7 Revegetation

Revegetation within the Western Offset will focus on the establishment of Box Gum Grassy Woodland and will be undertaken progressively to increase structural diversity and allow for adaptive management.

The extent, timing and methodologies of revegetation to be employed in the Western Offset will be determined on an annual basis. Prior to commencing revegetation works a site inspection would be undertaken by a suitably qualified person to identify areas which should be targeted and the specific methods required i.e. soil preparation, weed management, thinning and seed/tube stock densities and composition. Revegetation works within the Western Offset will not commence until existing leases have expired (i.e. once grazing has been excluded) as illustrated in the preliminary revegetation plan in Figure E-32 and Table E-60.

Revegetation methods to be employed in the Western Offset include Mechanical direct seed and tube stock planting, hand spot planting and hand broadcasting / niche seeding. Deep ripping and other soil amelioration will be undertaken in targeted areas where required (Figure E-46) to prepare the soil prior to seeding / planting.

Seed procurement will be determined after the site inspection and prior to revegetation works based on seed mix attributes provided in Table 6.6 of the main BMP document, availability of seed and in accordance with the current condition and regeneration occurring within the Western Offsets (Table E-54).

Fertilising of tube stock will be undertaken at the time of planting by adding 100 g of DAP (di-ammonium phosphate) under the soil surface within 250 mm of the tube stock. Planted

tubestock will be watered (approximately 5L/plant) at the time of planting and at least three times within the first year of growth (Table E-60).

Routine inspections will be undertaken within revegetation sites to identify plant stress and monitor mortality rates. Areas where high mortality rates are recorded will be revegetated and continually monitored.

E2.4.3 Monitoring and evaluation

Progress against the completion criteria developed for the Western Offset will be monitored as part of the Biodiversity Monitoring Program described in Section 7.2 of the main BMP document. Six reference sites (three in Habitat Management Zones and three in Habitat Restoration Zones) will be monitored within the Merriendi property, with specific indicators used to compare each site with a corresponding analogue site (Figure E-46 and Table E-61).

Table E-61 Summary of replicate monitoring sites in the Western Offset

Vegetation community	Management zone	No. monitoring sites
Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (PCT 610 / BVT NA 245)	Habitat management zone	1
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 1383 / BVT NA 226)		2
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 1383 / BVT NA 226) (Derive Native Grassland)	Habitat restoration zone	3

Appendix F

Threatened biodiversity implementation plans

Contents

F1 Introduction

These Threatened Biodiversity Implementation Plans outline specific implementation plans for threatened biodiversity recorded or predicted to occur in the Project Boundary and BOAs and has been developed to address the relevant CoA 44, 45 and 46 (Schedule 3) of the Planning Assessment Commission of NSW approval for the Project:

"Schedule 3, Condition 44:
For the White Box –Yellow Box – Blakeley's Red Gum Grassy Woodland Endangered Ecological Community the Proponent shall:

a) *Ensure that the Biodiversity Offset Strategy and Rehabilitation Strategy are focussed on protection, rehabilitation, re-establishment and long-term maintenance of viable stands of this community;*

b) *Investigate in consultation with OEH and the Namoi CMA, all factors likely to enhance or impede the effective long-term restoration of degraded remnants of this EEC in offset areas or regeneration of this EEC on disturbed areas (both offset areas and the site);*

c) *Within 24 months of the date of this approval (and if possible in conjunction with Stage 2 of the Leard Forest Mining Precinct Regional Biodiversity Strategy), submit a report for this investigation and provide an implementation plan to maximise the prospects for rehabilitation and regeneration of this EEC on the offset areas and the site, for approval by the Secretary:*

Schedule 3, Condition 45:
For all Threatened species on site, the proponent shall ensure that the Biodiversity Offset Strategy and Rehabilitation Strategy are focused on protection, rehabilitation and long-term maintenance of viable stands of suitable habitat for Threatened species.

Schedule 3 Condition 46:
The Proponent shall:

a) *Investigate, in consultation with OEH and the Namoi CMA, all factors likely to enhance or impede the effective long-term provision of suitable habitat(s) for the following species: Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella, Regent Honeyeater, Eastern False Pipistrelle, Greater Long-eared Bat, Yellow-bellied Sheath Tail Bat;*

b) *Within 24 months of the date of this approval (and if possible, in conjunction with Stage 2 of the Leard Forest Mining Precinct Regional Biodiversity Strategy), submit a report of this investigation and provide an implementation plan to ensure delivery of suitable areas of viable habitat for the species included in (a) above, for approval by the Secretary;"*

Implementation plans were developed for the Box Gum Grassy Woodland ecological community and threatened species listed in Table F-1, following an investigation of factors likely to enhance or impeded the effective long-term restoration of degraded remnants of Box Gum Woodland (consistent with Condition 44b of Schedule 3) and factors likely to enhance or impede the effective long-term provision of suitable habitat for threatened species listed in Table F-1 (consistent with Condition 46a of Schedule 3) (refer Section F3).

For the purposes of providing protection, restoration and long-term maintenance of viable stands of habitat through the BMP, various threatened species have been grouped together (guilds) due to their similarity in habitat requirements and susceptibility to impacts associated with the Project (Table F-1).

Table F-1 Targeted threatened biodiversity

Biodiversity values	BC Act[1]	EPBC Act[2]
Threatened ecological communities		
Box Gum Grassy Woodland	E	CE
Threatened fauna		
Threatened raptors (Little Eagle, Square-tailed Kite)	V	
Threatened owls (Barking Owl, Masked Owl)	V	
Threatened cave-dependent microchiropteran bats assessed as a group (Eastern Cave Bat, Eastern Bent-wing Bat, Large-eared Pied Bat and Little Pied Bat)	V	V[4]
Threatened hollow-dependent microchiropteran bats assessed as a group (Eastern False Pipistrelle, Corben's Long-eared Bat[3] and Yellow-bellied Sheathtail-bat)	V	V[3]
Turquoise Parrot	V	
Threatened woodland birds assessed as a group (Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella)	V	
Little Lorikeet	V	
Swift Parrot	E	CE
Spotted Harrier	V	
Black-necked Stork	E	
Superb Parrot	V	V
Regent Honeyeater	CE	CE
Spotted-tailed Quoll	V	E
Squirrel Glider	V	
Koala	V	V
Pale-headed Snake	V	

1) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the BC Act

2) Listed as Migratory (M), Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the EPBC Act

3) Corben's Long-eared Bat (syn. Greater Long-eared Bat)

4) Corben's Long-eared Bat and Large-eared Pied Bat only

Appendix F has been completed in conjunction with the Leard Forest Regional Biodiversity Strategy (Stage 2 – Strategy Report (Umwelt (Australia) Pty Limited 2017) for consistency between management actions, monitoring opportunities, performance measures and preliminary completion criteria.

F2 Consultation

Conditions 44 (b) and 46 (a) of the Boggabri Coal Mine Project Approval (PA 09_0182) (Section F1) require consultation with NSW Office of Environment and Heritage (OEH) and North West Local Land Services (formerly the Namoi Catchment Management Authority CMA). A summary of the consultation to date is provided below;

Idemitsu sent the BMP (Rev No. 1) including the Appendix F implementation plans for comment and review to SEWPAC, DP&I, OEH, Namoi CMA. Feedback provided by DP&I, and OEH was provided on 4 October 2012.

SEWPAC provided the following written correspondence on the 14th October 2012:

> *"As discussed, the department will start reviewing this plan but is unable to provide comments prior to a decision on the Boggabri Coal Project Extension. If the project is approved, the department will assess the Biodiversity Management Plan against any relevant conditions that are attached to that approval".*

The project has been approved and now the DoE will be able to complete the review of the BMP and implementation plans.

Namoi CMA provided comments on the BMP and Appendix F implementation plans on 2 October 2012 and identified that:

> *"Namoi CMA has reviewed the Draft BMP and found it to be consistent with the following Namoi CMA's plans and policies:*
>
> - *Namoi CMA's CAP 2010-2020*
> - *Namoi CMA — Extracted Industries Policy*
> - *Namoi CMA — Biodiversity Offset Strategy*
>
> *Namoi CMA is satisfied with the management measures and procedures contained in the Draft BMP."*

- On 20 November 2013 Idemitsu and Parsons Brinckerhoff met with OEH (Peter Christie and Sonya Ardill) to discuss the development of the revised BOS, threatened species management in particular the acquisition of identified additional offset properties.
- On 21 April 2015 Idemitsu and Parsons Brinckerhoff met with Peter Christie from OEH to present the revised BOS properties and implementation plans for threatened biodiversity.
- OEH identified that the revised BOS should include the species specific outcomes in regards to habitat provided within the biodiversity offsets, ratios and a split between the remnant and proposed restoration of derived grassland.
- OEH requested that the vegetation types within the biodiversity offset areas be linked to the state wide classification of vegetation (PCTs).

- On 23 April 2015 Idemitsu and Parsons Brinckerhoff met with Dennis Boschma from North West Local Land Services (NWLLS) to present and discuss the implementation plans for Threatened biodiversity. Dennis identified that the management of pine and shiny bush (woody weeds) within the Box Gum woodland as a key management issues for LLS and would be supportive of the proposed investigation into different treatment and control of these issues as proposed for Box Gum Woodland.

- On 4 June 2015 Boggabri Coal and Parsons Brinckerhoff met with Steve O'Donoghue from DP&I and OEH to inspect the recent biodiversity offset acquisitions. A number of management issues were raised during the inspections including, the potential for derived grasslands to be revegetation naturally vs unassisted, pest and weed management and edge effects from neighbouring properties and ability to adequately demonstrate restoration of significant erosion hazards. Following this inspection and a review of management actions for Box Gum woodland across the additional offsets, areas of significant erosions have been excluded from the revised BOS and implementation plans.

- Detailed ecological reports on the additional biodiversity and condition of the offset properties were also provided to DP&E in June 2015.

F3 Investigation plan for the provision of Box Gum Woodland and threatened fauna habitat

Table F-2 and Table F-3 detail proposed actions relating to factors that are likely to impede or enhance the provision of Box Gum Woodland and habitat for threatened species of fauna. As many of the threatened fauna species listed in Table F-1 use Box Gum Woodland as habitat, factors relating to the re-establishment and restoration of Box Gum Woodland are applicable to threatened species of fauna.

The provision of habitat management zones, habitat restoration zones and corridor enhancement zones, together with rehabilitation (re-establishment) of post mine landform, will over time provide a range habitats that can be used by threatened fauna species. Although the provision of suitable habitat does not in itself ensure the presence of any such species, it is possible to seek to optimise the potential habitat for such species to ultimately occupy these landscapes.

Table F-2 Proposed actions relating to factors likely to impede and enhance the re-establishment and restoration of Box Gum Woodland

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
1. Substrate	1a. Poor soil chemistry – depleted soil nutrients (Eddy, 2002)/	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Avoidance of soils with high or low pH, high salinity, low fertility or sodic soils. ▪ Rehabilitation trials ▪ Nutrient management options: ‣ Amelioration of soils with agricultural gypsum, compost (i.e. mulch saved during clearing activities) or fertilisers depending on the nutrient deficiency. ‣ Addition of woody debris to increase carbon levels (Harmon et al. 1986; Debeljak, 2006; Manning et al. 2013; Goldin and Brookhouse, 2014). ‣ Use of Biochar to increase soil carbon	The RMP will: ▪ Provide parameters for the physical and chemical characteristics of topsoils and overburden based on likely suitable characteristics for establishment of Box Gum Woodland. ▪ Provide for soil testing to be undertaken on topsoil and overburden to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Describe options for ameliorating soils to improve the suitability of the soils as a growth media (e.g. amelioration with agricultural gypsum, compost (i.e. mulch saved during clearing activities) or fertilisers depending on the nutrient deficiency). ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch. ▪ Provide for selective use of slow-release native plant fertiliser (e.g. rock minerals) to promote plant growth (if required).
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ Limited and selective use of specific fertilisers to facilitate growth of tube stock (Eddy, 2002). ▪ Placement of woody debris to increase carbon and moisture levels (Goldin and Brookhouse, 2014).	The BMP will: ▪ Provide for soil testing to be undertaken on soils in revegetation areas to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Provide for selective use of slow-release fertiliser to promote plant growth (if required). ▪ Describe procedures to reuse timber/hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA).
	1b. Poor soil chemistry - elevated soil nutrients, salinity and acid soils (Rawlings et al. 2010; Department of the Environment, Climate Change and Water [DECCW], 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Avoidance of soils with high or low pH, high salinity, low fertility or sodic soils. ▪ Application of minimum topsoil and subsoil depths ▪ Soil handling processes for removal, storage and re-layering of topsoil and subsoil ▪ Rehabilitation trials.	The RMP will: ▪ Provide parameters for the physical and chemical characteristics of topsoils and overburden based on likely suitable characteristics for establishment of Box Gum Woodland. ▪ Provide for soil testing to be undertaken on topsoil and overburden to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Describe minimum topsoil and subsoil depths for revegetation. ▪ Provide soil handling processes for removal, storage and re-layering of topsoil and subsoil, including the length and mode of topsoil storage. ▪ Provide for rehabilitation trials
	1c. Poor soil chemistry - elevated soil nutrients (Prober et al. 2002; Rawlings et al. 2010; DECCW, 2010)	Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ No application of fertilizers on soils with elevated concentrations of the same nutrients (Rawlings et al. 2010). ▪ Nutrient management options to lower soil nitrogen and phosphorus levels: ‣ Crash grazing periodically to remove nutrients locked in weeds (Rawlings et al. 2010). ‣ Restriction of livestock access to limit further nutrient enrichment (Rawlings et al. 2010). ‣ Hay cutting (Rawlings et al. 2010) ‣ Controlled burns (Rawlings et al. 2010). ‣ Carbohydrate addition (Rawlings et al. 2010) ‣ Topsoil removal (scalping) (corridor enhancement zone only) (Gibson-Roy *et al.* 2010; Rawlings *et al.* 2010)	The BMP will: ▪ Provide for soil testing to be undertaken on soils in revegetation areas to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Describe the following nutrient reduction options: ‣ crash grazing periodically to remove nutrients locked in weeds; ‣ restriction of livestock access to limit further nutrient enrichment; ‣ controlled burns.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
	1d. Erosion and sedimentation (Rawlings et al. 2010; DECCW, 2010; Tongway and Ludwig, 2011)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Establishing vegetation cover as soon as practicable. ▪ Adjust seed and planting densities to maximise ground cover. ▪ Treatment of dispersive soils and spoils. ▪ Design of the batter slopes to be stable. ▪ Use of structural erosion controls (e.g. channel banks, slope drains and energy dissipaters). ▪ Exclusion of livestock (Rawlings et al. 2010). ▪ Use of benign (hard rock) mulch to stabilise batter surfaces. ▪ Ecological monitoring of mine rehabilitation	The RMP will: ▪ Provide for establishing vegetation cover as soon as practicable following disturbance to minimise the potential for erosion and weeds. This will involve the application of a temporary sterile cover crop (or native grasses) using species that are not likely to impede revegetation of the Box Gum Woodland. ▪ Provide options for remediating erosion including adjust seed and planning densities to maximise ground cover. ▪ Provide options for minimising the risk of erosion including treatment of dispersive soils and spoils, as well as use of use of structural erosion controls (e.g. channel banks, slope drains and energy dissipaters). ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Consider the use of benign (hard rock) mulch to stabilise batter surfaces that has been sourced onsite (i.e. salvaged from clearing areas or from waste material). ▪ Include ecological monitoring of mine rehabilitation.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ Targeting revegetation along drainage lines. ▪ Remediation of scalded areas. ▪ Restriction of livestock access (particularly along drainage lines) (Rawlings et al. 2010). ▪ Maximised re-use of existing infrastructure (e.g. access roads) instead of creating new infrastructure. ▪ Ecological analysis to identify constraints and requirements for specific management measures (Tongway and Ludwig, 2011).	The BMP will: ▪ Describe restriction of livestock access. ▪ Aim to maximise the re-use of existing infrastructure (e.g. access roads) instead of creating new infrastructure.
	1e. Soil compaction - inhibits germination of seeds or growth of seedlings (Eddy, 2002; Department of Sustainability and the Environment [DSE], 2005; Rawlings et al. 2010; DECCW, 2010)	Mine Rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Restriction of vehicle access to avoid compacting soil (Eddy, 2002; DSE, 2005). ▪ Pre-planting site preparation (e.g. ripping) (Rawlings *et al.* 2010). ▪ Exclusion of livestock (Rawlings *et al.* 2010). ▪ Mulching (Rawlings *et al.* 2010). ▪ Use of spiked rollers/ air jetting to aerate soils to depth of 30 cm.	The RMP will: ▪ Describe that vehicle access will be predominantly restricted to designated tracks on mine landforms that have been revegetated to minimise ground disturbance (e.g. compaction). ▪ Describe site preparation (e.g. ripping or use of spiked rollers) to reduce soil compaction impacting the success of the revegetation. ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Restriction of vehicle access to avoid compacting soil (Eddy, 2002; DSE, 2005). ▪ Restriction of livestock access (Rawlings *et al.* 2010). ▪ Options for reducing compaction: ‣ Mulching (Rawlings et al. 2010) ‣ Hand aeration (Rawlings et al. 2010) ‣ Deep air-jetting and mulching (Rawlings et al. 2010) ‣ Cultivation followed by mulching (Rawlings *et al.* 2010).	The BMP will: ▪ Describe that vehicle access will be predominantly restricted to designated tracks to minimise ground disturbance (e.g. compaction). ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Describe site preparation in cleared land (e.g. ripping or use of spiked rollers) and (where relevant) in derived grassland (e.g. use of spiked rollers) to reduce soil compaction impacting the success of the revegetation.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat management and habitat restoration zones	▪ Restriction of vehicle access to avoid compacting soil (Eddy, 2002; DSE, 2005). ▪ Restriction of livestock access (Rawlings *et al.* 2010).	
	1f. Ground disturbance (Eddy, 2002; Rawlings et al. 2010)	Biodiversity offset areas - re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Restriction of vehicle access to avoid unnecessary ground disturbance (Eddy, 2002; DSE, 2005). ▪ Fencing and signage.	The BMP will: ▪ Describe that vehicle access will be predominantly restricted to designated tracks to minimise ground disturbance (e.g. compaction).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and habitat management zones	▪ Avoidance of revegetation techniques that involve high level of physical disturbance (i.e. cultivation, ripping and excavation) (Eddy, 2002; DECCW, 2010). ▪ Restriction of vehicle access to avoid unnecessary ground disturbance (DSE, 2005; Eddy, 2002). ▪ Fencing and signage.	▪ Describe provision of fencing and signage around the perimeter of the offset areas to manage livestock and avoid accidental clearance. ▪ Restrict the use of revegetation techniques that involve high level of physical disturbance in existing Box Gum Woodland and derived grasslands.
	1g. Depleted soil seed bank (DECCW, 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Management of topsoil seed resource. ▪ Soil seed bank germination testing (rehabilitation trials). ▪ Supplementary seeding/tube stock planting (Gibson-Roy et al. 2010).	The RMP will: ▪ Provide soil handling processes for removal, storage and re-layering of topsoil and subsoil ▪ Provide for soil seed bank germination testing to be undertaken on topsoil stockpiles. ▪ Describe a contingency for supplementary seeding/tube stock planting if the regeneration from the soil seed bank is not sufficient.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ Supplementary seeding/tube stock planting.	The BMP will: ▪ Favour natural regeneration in the habitat management and habitat restoration zones over seeding or planting in the first instance, followed by seeding or planting where applicable.
	1h. Insufficient topsoil and/or topsoil depth (DECCW, 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Application of minimum topsoil and subsoil depths ▪ Soil handling processes for removal, storage and re-layering of topsoil and subsoil	The RMP will: ▪ Describe minimum topsoil and subsoil depths for revegetation. ▪ provide soil handling processes for removal, storage and re-layering of topsoil and subsoil
	1i. Poor soil water holding capacity (Eddy, 2002)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Amelioration of soils with compost/woody debris. ▪ Selective placement of soils. ▪ Addition of woody debris (Harmon et al. 1986; Debeljak, 2006; Manning et al. 2013; Goldin and Brookhouse, 2014)	The RMP will: ▪ Describe options for ameliorating soils to improve the suitability of the soils as a growth media (e.g. amelioration with agricultural gypsum, compost or fertilisers depending on the nutrient deficiency). ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch. ▪ Describe matching flora to landform position.
	1j. Instability of the final landform	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Design of the batter slopes to be stable. ▪ Selective placement of soils. ▪ Use of benign (hard rock) mulch to stabilise batter surfaces.	The RMP will: ▪ Describe how the batter slopes have been designed to minimise instability of the final landform. ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Consider the use of benign (hard rock) mulch to stabilise batter surfaces that has been sourced onsite (i.e. salvaged from clearing areas or from waste material).
	1k. Poor drainage of the final landform (Eddy, 2002)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Design of the batter slopes to be stable. ▪ Amelioration of soils with compost.	The RMP will: ▪ Describe how the batter slopes have been designed to minimise instability of the final landform. ▪ Describe options for ameliorating soils to improve the suitability of the soils as a growth media (e.g. amelioration with agricultural gypsum, compost or fertilisers depending on the nutrient deficiency).
	1l. Lack of soil mycorrhizae (Jasper, 2007)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Application of minimum topsoil and subsoil depths ▪ Soil handling processes for removal, storage and re-layering of topsoil and subsoil ▪ Use of rhizobia bacteria inoculants for acacia (CSIRO, 2005).	The RMP will: ▪ describe minimum topsoil and subsoil depths for revegetation ▪ Provide soil handling processes for removal, storage and re-layering of topsoil and subsoil.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
2. Clearing	2a. Incidental clearing, fragmentation and fire wood collection	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Restriction on clearing.	The RMP will: ▪ Describe that mine rehabilitation would not be cleared (unless for ecological thinning, maintenance or access for monitoring).
		Biodiversity offset area – re-establishment of Box Gum Woodland within corridor enhancement habitat restoration and habitat management zones	▪ Restriction on clearing. ▪ Restriction on fire wood collection. ▪ Fencing and signage. ▪ Maximise re-use of existing infrastructure (e.g. access roads) ▪ Where necessary, new infrastructure should be installed in cleared land (e.g. access roads) ▪ Use of low disturbance methods for site preparation in derived grasslands and existing Box Gum Woodland.	The BMP will: ▪ Describe a restriction of clearing (unless for ecological thinning of density regrowth [i.e. selective removal of regrowth trees or shrubs], maintenance or access for monitoring). ▪ Not permit firewood collection. ▪ Describe provision of fencing and signage around the perimeter of biodiversity offset areas to manage livestock (i.e. exclusion or controlled entry of livestock for specific purposes) and avoid accidental clearance. ▪ Aim to maximise the re-use of existing infrastructure (e.g. access roads) instead of creating new infrastructure. ▪ Aim to locate new offset area management infrastructure (e.g. access roads) preferentially in cleared land.
3. Livestock	3a. Grazing by cattle – ground disturbance, remove or destroy seeds, seedlings or plantings (DSE, 2005; Rawlings *et al*. 2010)	Biodiversity offset area – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Fencing of areas undergoing revegetation to exclude grazing livestock and prevent grazing of seedlings (Eddy, 2002). ▪ Maintenance of fencing used to exclude livestock.	The BMP will: ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Describe restriction of livestock access to areas not already subject to grazing. ▪ Describe management of livestock to maintain ground cover and diversity of native plants. ▪ Describe restriction of livestock access to protect plants that are known to be sensitive to grazing. ▪ describe the following controlled grazing management options: ‣ Rotational grazing system to promote and maintain plant diversity and cover. ‣ Removal of grazing livestock.
		Biodiversity offset areas re-establishment of Box Gum Woodland within habitat restoration zones	▪ Restriction of livestock access (particularly along drainage lines) (Rawlings *et al.* 2010). ▪ Restriction of livestock access to protect plants that are known to be sensitive to grazing (Rawlings *et al.* 2010). ▪ Restriction of livestock access to maintain ground cover. ▪ Maintenance of fencing used to exclude livestock. ▪ Controlled grazing management options: ‣ Crash grazing periodically to remove nutrients locked in weeds (Rawlings *et al.* 2010). ‣ High intensity short duration rotational grazing (Rawlings *et al.* 2010). ‣ Removal of grazing livestock. ▪ Low stocking rates.	
		Biodiversity offset areas - restoration of habitat management zones	▪ Exclusion of livestock grazing along watercourses (McIvor and McIntyre, 2002). ▪ Exclusion of livestock grazing in areas not already subject to grazing (DECCW, 2010). ▪ Maintenance of fencing used to exclude livestock. ‣ Controlled grazing management (low stocking rates).	
		Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Weed control ▪ Establishing vegetation cover as soon as practicable following disturbance ▪ Application of a temporary sterile cover crop, or native grass cover crop established from native hays. ▪ Minimal unnecessary ground disturbance that may create opportunities for weeds (Rawlings *et al.* 2010; DECCW, 2010). ▪ Nutrient management (e.g. exclusion of grazing livestock which add nutrients) (Prober *et al.* 2002; Rawlings *et al.* 2010). ▪ General weed hygiene (e.g. avoiding driving through weed infestations) (DECCW, 2010).	The RMP will ▪ Describe procedures to prevent, monitor and control weeds. The RMP will also describe relevant targets and performance indicators for weed management ▪ Provide for establishing vegetation cover as soon as practicable following disturbance to minimise the potential for erosion and weeds. ▪ Provide application rates for seeds as well as planting densities for tube stock to avoid excessive shading. ▪ Include sowing of Kangaroo Grass (as this species is known to out-compete annual grass weeds and provide inter tussock spaces for a diversity of ground cover species [e.g. wildflowers).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
			▪ Correct spacing for species when planting seedlings to avoid excessive shading (Rawlings *et al.* 2010). ▪ Provisions to identify new invasive plant species (e.g. weed monitoring). ▪ Weed management options: ‣ Physical Removal (e.g. removing weeds by felling or pulling) (Gibson-Roy *et al.* 2010; Rawlings *et al.* 2010). ‣ Herbicide (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings *et al.* 2010; DECCW, 2010). ▪ Sowing of Kangaroo Grass to outcompete annual grass weeds (Prober *et al.* 2002; Rawlings *et al.* 2010).	
4. Introduced flora species (weeds)	4a. Weed invasion – perennial and annual grasses, perennial herbs, annual and biennial herbs and woody weeds (DSE, 2005; Rawlings *et al.* 2010; Gibson-Roy *et al.* 2010; DECCW, 2010)	Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Minimal unnecessary ground disturbance that may create opportunities for weeds (Eddy, 2002; DSE, 2005; Rawlings *et al.* 2010). ▪ Correct spacing for species when planting seedlings to avoid excessive shading (DECCW, 2010). ▪ Weed management options: ‣ Crash grazing periodically to reduce annual and perennial grass weeds (Rawlings et al. 2010). ‣ Nutrient management (e.g. exclusion of grazing livestock which add nutrients) (Rawlings et al. 2010). ‣ Controlled burns during spring to reduce annual and perennial grass weeds (not broadleaf exotics) (Rawlings et al. 2010). ‣ Physical Removal (e.g. removing weeds by felling or pulling) (Gibson-Roy et al. 2010; Rawlings et al. 2010). ‣ Herbicide (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings et al. 2010; DECCW, 2010). ‣ Sowing of Kangaroo Grass to outcompete annual grass weeds (Prober et al. 2002; Rawlings et al. 2010). ‣ Scalping to remove weed seed bank (Gibson-Roy et al. 2010).	The BMP will: ▪ Provide application rates for seeds as well as planting densities for tube stock to avoid excessive shading. ▪ provide the following weed management options: ‣ Crash grazing periodically to reduce annual and perennial grass weeds. ‣ Nutrient management (e.g. exclusion of grazing livestock which add nutrients). ‣ Controlled burns (except in revegetation areas) during spring to reduce annual and perennial grass weeds (not broadleaf exotics). ‣ Physical Removal (e.g. removing weeds by felling or pulling). ‣ Targeted and timely herbicide application. ‣ Include sowing of Kangaroo Grass (as this species is known to out-compete annual grass weeds and provide inter tussock spaces for a diversity of ground cover species [e.g. wildflowers]).
		Biodiversity offset areas – re-establishment of Box Gum Woodland within habitat restoration and habitat management zones	▪ Minimal unnecessary ground disturbance that may create opportunities for weeds (Eddy, 2002; DSE, 2005; Rawlings *et al.* 2010). ‣ Light grazing in autumn and/or winter to reduce vigour of annual grass weeds (Rawlings *et al.* 2010).	The BMP will: ▪ Include provision to lightly graze derived grasslands in times of suitable climatic conditions for weed growth (e.g. autumn and/or winter) to reduce vigour of annual grass weeds.
5. Herbicide	5a. Excessive herbicides – may have a negative effects on native species (Eddy, 2002)	All areas	▪ Use herbicides sparingly (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings *et al.* 2010; DECCW, 2010).	The RMP and BMP will: ▪ Provide methods for the use of herbicides (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods).
6. Impacts from animals	6a. Grazing by feral pigs and goats – remove or destroy seeds, seedlings or plantings (Eddy, 2002; Rawlings *et al.* 2010; DECCW, 2010; DSE 2005)	All areas	▪ Monitoring and control feral pigs and goats (Eddy, 2002; Rawlings *et al.* 2010; DSE, 2005). ▪ Use of tree guards to protect young seedlings from browsing or grazing (Rawlings *et al.* 2010).	The RMP and BMP will: ▪ Describe procedures to prevent, monitor and control feral animals (including feral pigs, goats, rabbits and foxes). ▪ Provide an option for using tree guards to protect young seedlings from browsing or grazing native animals.
	6b. Feral foxes and cats (Eddy, 2002; DECCW, 2010)	All areas	▪ Monitoring and control of feral foxes and cats (Eddy, 2002; Rawlings *et al.* 2010).	The RMP and BMP will: ▪ Describe procedures to monitor and control feral animals (including feral pigs, goats, rabbits and foxes).
	6c. Other Invasive Fauna	All areas	▪ Provisions to identify new invasive fauna species (e.g. ecological monitoring).	The RMP and BMP will: ▪ Provide provisions to identify new invasive fauna species (e.g. ecological monitoring).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
7. Fire	7a. Uncontrolled bushfire (DECCW, 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ No controlled burns whilst vegetation is establishing. ▪ Maintain fire breaks and access. ▪ Assess fuel loads.	The RMP will: ▪ Describe measures to prevent fires, such as maintaining fire breaks and access (i.e. no controlled burns would be undertaken on the mine rehabilitation whilst vegetation is establishing).
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement and habitat restoration zones	▪ Not controlled burns whilst vegetation is establishing. ▪ Maintain fire breaks and access. ▪ Controlled grazing to reduce biomass (Rawlings *et al.* 2010).	▪ The BMP will: ‣ describe measures to prevent fires, such as maintaining fire breaks and access. ‣ provision for maintenance of fire breaks and fire trails. ▪ provide an option for using controlled grazing to reduce biomass.
8. Floristics	8a. Poor diversity in the seed mix or tube stock	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Monitoring of plant growth and survival (Rawlings *et al.* 2010). ▪ Strategic and long term seed collection, management and storage. ▪ Site preparation and depth of sowing seed. ▪ Supplementary planting or reseeding of absent species.	The RMP will: ▪ Describe how the growth and survival of the vegetation sown or planted will be monitored. ▪ Describe procedures for seed collection, management and storage.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Strategic and long term seed collection, management and storage. ▪ Site preparation and depth of sowing seed. ▪ Supplementary planting or reseeding of absent species.	The BMP will: ▪ Describe procedures for seed collection, management and storage. ▪ Describe procedures for sowing seed. ▪ Favour natural regeneration in the habitat restoration and habitat management zones over seeding or planting in the first instance followed by seeding or planting if required.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within habitat restoration zones	▪ Favour natural regeneration over seeding or planting in the first instance followed by seeding or planting if required (McIntyre, 2002).	
	8b. Unsuitable species in the seed mix or tube stock	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Preferential use of local endemic (adapted) species (Rawlings *et al.* 2010).	The RMP will: ▪ Provide for the preferential use of local endemic (adapted) species.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Preferential use of local endemic (adapted) species (Rawlings *et al.* 2010).	The BMP will ▪ Provide for the preferential use of local endemic (adapted) species. ▪ Favour natural regeneration in habitat restoration and habitat management zones over seeding or planting in the first instance followed by seeding or planting if required.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within habitat restoration zones	▪ Favour natural regeneration over seeding or planting in the first instance followed by seeding or planting if required (McIntyre, 2002).	
	8c. Shortage of sufficient seed or tube stock	All areas	▪ Review commercial seed and tube stock availability.	The RMP and BMP will: ▪ Describe a seed and tube stock supply strategy.
	8d. Poor understorey diversity	All areas	▪ Planting of trees and shrubs at appropriate densities (DECCW, 2010). ▪ Use local endemic (adapted) species (Eddy, 2002; Rawlings *et al.* 2010). ▪ Restore linkages to existing woodland patches. ▪ Assess whether ecological thinning is necessary (Rawlings *et al.* 2010). ▪ Consider causing disturbance (e.g. through fire or grazing) (Eddy, 2002). ▪ Include a wide diversity of species in the seed mix (Gibson-Roy *et al.* 2010).	The RMP and BMP will: ▪ Provide for the preferential use of local endemic (adapted) species. ▪ Include provision to assess vegetation density and undertake ecological thinning if necessary. ▪ Provide measures to improve understorey diversity (e.g. replanting, causing disturbance through fire or grazing). ▪ Aim to include a wide diversity of species in the seed mix.
9. Native plant growth	9a. Poor native plant growth	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Site preparation and depth of sowing seed. ▪ Correct spacing for species when planting seedlings to avoid excessive shading (Rawlings et al. 2010).	The RMP will: ▪ Describe procedures for seed collection, management and storage. ▪ Provide for the preferential use of local endemic (adapted) species,

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
			▪ Supplementary seeding or planting. ▪ Revegetation trials ▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010) ▪ Selective use of specific fertilisers only.	▪ Provide for selective use of slow-release fertiliser to promote plant growth (if required).
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement and habitat restoration zones	▪ Site preparation and depth of sowing seed. ▪ Fencing of areas undergoing revegetation to exclude grazing livestock. ▪ Correct spacing for species when planting seedlings to avoid excessive shading (Rawlings et al. 2010). ▪ Supplementary seeding or planting. ▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010).	The BMP will ▪ Describe procedures for seed collection, management and storage. ▪ Describe how livestock will be excluded from areas undergoing active restoration (i.e. planting or seeding). ▪ Provide application rates for seeds as well as planting densities for tube stock to avoid excessive shading. ▪ Favour natural regeneration in habitat restoration and habitat management over seeding or planting in the first instance followed by seeding or planting if required. ▪ Provide for the preferential use of local endemic (adapted) species.
	9b. Poor seed germination	All areas	▪ Supplementary seeding or planting. ▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010). ▪ Seed scarification for acacia or heat treatment.	The RMP and BMP will: ▪ Favour natural regeneration in habitat restoration and habitat management zones over seeding or planting in the first instance followed by seeding or planting if required. ▪ The RMP and BMP will provide for the preferential use of local endemic (adapted) species.
	9c. Dense overstorey and midstorey revegetation (e.g. White Cypress Pine) – sometimes regeneration is too successful and trees may compete with each other for light, water and nutrients (Rawlings *et al.* 2010; DECCW, 2010)	All areas	▪ Assess whether ecological thinning is necessary (Rawlings et al. 2010). ▪ Thinning with fire or manually (Rawlings et al. 2010).	The RMP and BMP will: ▪ Include provision to assess vegetation density and undertake ecological thinning (e.g. through selective clearance or fire) if necessary.
	9d. Dense grass cover	All areas	▪ Consider causing disturbance (e.g. through fire or grazing) (Rawlings et al. 2010).	The RMP and BMP will: ▪ Provide measures to improve understorey diversity (e.g. replanting, causing disturbance).
	9e. Disease (e.g. *Phytophthora cinnamomi*) (DECCW, 2010)	All areas	▪ Hygiene protocols to minimise the risk of plant diseases (Rawlings et al. 2010).	The RMP and BMP will: ▪ Include hygiene protocols to minimise the risk of plant diseases (i.e. restricting site access).
	9f. Fungi or pathogens – may cause germination failure (seeds) (Rawlings *et al.* 2010).	All areas	▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010).	The RMP and BMP will: ▪ Provide for the preferential use of local endemic (adapted) species.
10. Fauna habitat	10a. Lack of bush rocks (Michael *et al.* 2011)	All areas	▪ Maximise salvage and reuse of bush rocks (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures for the reuse of bush rocks salvaged during vegetation clearing activities (consistent with Condition 36] Schedule 3 of Project CoA).
	10b. Lack of fallen timber/hollow logs (DECCW, 2010)	All areas	▪ Maximise salvage and reuse of woody debris/ hollow logs (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures for the reuse of woody debris/ hollow logs salvaged during vegetation clearing activities (consistent with Condition 36 Schedule 3 of Project CoA),
	10c. Lack of structural diversity (Manning *et al.* 2011; Michael *et al.* 2011; Freudenberger *et al.* 2004)	All areas	▪ Planting of scattered low shrubs, mid-sized shrubs and tall trees (Freudenberger *et al.* 2004). ▪ Maximise salvage and reuse timber/hollow logs (Condition 36 Schedule 3 of Project CoA).	The RMP and BMP will: ▪ Describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create structurally diverse habitat.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
			▪ Increase woodland patch size within biodiversity offset areas (Prober *et al*. 2002).	▪ Describe procedures to reuse of bush rocks salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA). ▪ Describe procedures to reuse of timber/hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA ▪ Focus on increasing woodland patch size within biodiversity offset areas and aim to enhance ecological connectivity.
11. Surrounding land uses	11a. Agriculture - pesticides and herbicides	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010).	The BMP will: ▪ Focus on increasing woodland patch size within biodiversity offset areas and aim to enhance ecological connectivity.
	11b. Agriculture -exotic species (including incursions of stock and feral animals)	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010). ▪ Fencing and signage.	
	11c. Agriculture - increased runoff	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010).	
	11d. Agriculture -nutrient enrichment	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010).	
12. Weather	12a. Drought	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Monitoring for signs of water stress (dieback). ▪ Irrigation. ▪ Mulch.	The RMP will: ▪ Describe how the growth and survival of the vegetation sown or planted will be monitored. ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement and habitat restoration zones	▪ Monitoring for signs of water stress (dieback). ▪ Limit grazing livestock during drought periods (DECCW, 2011). ▪ Irrigation. ▪ Mulch.	The BMP will ▪ Describe how the growth and survival of the vegetation sown or planted will be monitored. ▪ Discuss an adaptive management framework and monitoring program for the management of the Box Gum Woodland EEC. ▪ Provide a mechanism to reduce livestock grazing during drought periods.
	12b. Flood/major rainfall	All areas	▪ Refer to 1d. Erosion and sedimentation.	
	12c. Wind	All areas	▪ Only use healthy seedlings (Rawlings *et al.* 2010).	The RMP and BMP will: ▪ provide for establishing vegetation cover as soon as practicable following disturbance to minimise the potential for erosion and weeds, using species that are not likely to impede revegetation of the Box Gum Woodland.
	12d. Climate change (DECCW, 2010)	All areas	▪ Restoration of Box Gum Woodland (DECCW, 2010). ▪ Use of genetically diverse collections of seed sourced from large and healthy populations. ▪ Increase woodland patch size within biodiversity offset areas (to provide links for movement of plant propagules and fauna).	The RMP and BMP will: ▪ Focus on increasing woodland patch size within biodiversity offset areas and aim to enhance ecological connectivity. ▪ Provide for the preferential use of local endemic (adapted) species.
13. Management	13a. Unclear objectives	All areas	▪ Define objectives (Eddy, 2002; Rawlings *et al.* 2010). ▪ Management for patchiness (diversity) (Rawlings *et al.* 2010).	The RMP and BMP will: ▪ Define the objectives for the Box Gum Woodland. ▪ Discuss an adaptive management framework and monitoring program for the management of the Box Gum Woodland.
	13b. Lack of maintenance	All areas	▪ Adaptive management (Rawlings *et al.* 2010; Tongway and Ludwig, 2011).	
	13c Poor monitoring design (measurement of success)	All areas	▪ Monitor to determine effectiveness (Eddy, 2002; DECCW, 2010). ▪ Monitoring closely linked to objectives. ▪ Use of photo-points to monitor changes over time (Eddy, 2002).	
	13d. Unqualified personnel	All areas	▪ Engage suitability qualified personnel	The RMP and BMP will: ▪ describe roles for suitability qualified personnel

Table F-3 Proposed actions relating to factors likely to impede and enhance the provision of habitat for threatened species of fauna

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
1. Adequate availability of prey species The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform, together with the salvage and re-use of woody debris and hollows, will over time provide a range of suitable habitats for invertebrates and vertebrates that provide a potential source of food for various threatened fauna species.	1a. Lack of invertebrates as a food source (Spotted Harrier, Little Eagle, Barking Owl, Brown Treecreeper, Painted Honeyeater, Grey-crowned Babbler, Varied Sittella, Squirrel Glider, hollow-dependent and cave dependent microchiropteran bats) (OEH, 2015)	Primarily relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities to encourage invertebrate habitation that provide a potential food source (Condition 36 Schedule 3 of Project CoA). ▪ Mulching to encourage invertebrates that provide a potential food source.	▪ The RMP and BMP will describe procedures to reuse woody debris and hollow logs salvaged during vegetation clearing (consistent with Condition 36 Schedule 3 of Project CoA). ▪ The RMP will describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch.
	1b. Lack of reptiles as a food source (Pale-headed Snake, Spotted Harrier, Little Eagle) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of bush rocks from the mine vegetation clearing activities to encourage reptile habitation that provide a potential food source (Condition 36 Schedule 3 of Project CoA). ▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities to encourage reptiles that provide a potential food source (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures to reuse bush rocks, woody debris and hollow logs salvaged during vegetation clearing activities (consistent with Condition 36 Schedule 3 of Project CoA).
	1c. Lack of birds as a food source (Square-tailed Kite, Spotted Harrier, Little Eagle, Barking Owl) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Plant scattered low shrubs, mid-sized shrubs and tall trees to encourage birds that provide a potential food source. ▪ Provision of large areas of suitable woodland within biodiversity offset areas and mine rehabilitation areas to encourage birds that provide a potential food source (Prober *et al.* 2002).	▪ The RMP and BMP will describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create a structurally diverse habitat.
	1d. Lack of small mammals as a food source (Pale-headed Snake, Spotted Harrier, Little Eagle, Masked Owl, Barking Owl) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities to encourage small mammals that provide a potential food source (Condition 36 Schedule 3 of Project CoA). ▪ Placement of nest boxes and/or hollow limbs (in young trees without hollows) from the mine vegetation clearing activities to encourage small mammals that would provide a potential food source for predators.	▪ The RMP and BMP will describe procedures to reuse woody debris and hollow logs salvaged during vegetation clearing and/or suitable nest boxes (consistent with Condition 36 Schedule 3 of Project CoA), including placement of hollow limbs and some select trees without hollows and/or appropriate nest boxes.
2. Nesting habitat (mainly birds) The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform will over time provide suitable vegetation in which some threatened fauna species may nest. Additionally, salvage and re-use of logs and hollows could facilitate other threatened fauna species to nest in the short-term.	2a. Lack of suitable vegetation (Spotted Harrier, Little Eagle, Speckled Warbler, Regent Honeyeater) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ As part of a diverse seed mix/tube stock planting list plant: ‣ Tall tree species. ‣ Low, dense species (Speckled Warbler). ‣ Eucalypts (Masked Owl, Regent Honeyeater, Painted Honeyeater, Grey-crowned Babbler). ‣ Native, tussocky grasses (Speckled Warbler). ‣ Allocasuarina*/Casuarina* species (Regent Honeyeater, Painted Honeyeater). ‣ *Acacia* species (Painted Honeyeater).	The RMP and BMP will: ▪ Describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create structurally diverse habitats. ▪ Include the planting (in appropriate soil landscapes) of a variety of eucalypt species. ▪ Include the planting of a variety of native grasses including tussock grass species. ▪ Include the planting of *Allocasuarina* and *Casuarina* species. ▪ Include the planting of *Acacia* species, including both tree and shrub varieties.
	2b. Lack of hollows (Brown Treecreeper, Little Lorikeet, Turquoise Parrot, Barking Owl, Masked Owl, Squirrel Glider, hollow dependent microchiropteran bats, Pale-headed Snake) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of woody debris/hollow logs from the mine vegetation clearing activities (Condition 36 Schedule 3 of Project CoA), including placement of nest boxes and/or hollow limbs in select trees without hollows.	▪ The RMP and BMP will describe procedures to reuse woody debris and hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA), including placement of hollow limbs or artificial hollows in some select trees without hollows.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
	2c. Lack of fallen timber (Speckled Warbler, Brown Treecreeper) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of fallen timber/hollow logs from the mine vegetation clearance activities (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures to reuse fallen timber/hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA).
	2d. Lack of suitable vegetation along/near watercourses (Square-tailed Kite, Barking Owl) (OEH, 2015)	Predominantly relevant to watercourses in the biodiversity offset areas.	▪ As part of a diverse seed mix/tube stock planting list, plant trees (particularly eucalypts) along water courses (Square-tailed Kite, Barking Owl).	▪ The RMP and BMP will include the planting of eucalypt species along water courses where applicable within the rehabilitation area.
3. Foraging and roosting habitat The restoration of native vegetation communities in biodiversity offset areas and rehabilitation of the post mine landform will over time provide suitable vegetation in which some threatened fauna species may forage and roost.	3a. Lack of suitable tree species (Square-tailed Kite, Spotted Harrier, Little Eagle, Little Lorikeet, Turquoise Parrot, Superb Parrot, Masked Owl, Barking Owl, Brown Treecreeper, Speckled Warbler, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Hooded Robin, Grey-Crowned Babbler, Varied Sittella, Diamond Firetail, Koala, Squirrel Glider, Eastern Bentwing-bat, Greater Long-eared Bat, Large-eared Pied Bat, Little Pied Bat, Eastern False Pipistrelle, Eastern Cave Bat) (Marchant & Higgins, 1993; Garnett & Crowley 2000; Higgins, 1999; Barea, 2008; Churchill, 2008; Department of Environment and Climate Change, 2008a; OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Plant eucalypts (Pale-headed Snake, Little Eagle, Turquoise Parrot, Superb Parrot, Rainbow Bee-eater, Satin Flycatcher, Masked Owl, Brown Treecreeper, Speckled Warbler, Painted Honeyeater, Hooded Robin, Grey-crowned Babbler, Varied Sittella, Koala, Squirrel Glider, Greater Long-eared Bat, Eastern Cave Bat), in particular: ‣ box, ironbark and gum species (Square-tailed Kite, Black-chinned Honeyeater, Painted Honeyeater, Squirrel Glider); ‣ White Box (*Eucalyptus albens*) (Little Lorikeet, Swift Parrot, Superb Parrot, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Grey-Crowned Babbler, Diamond Firetail, Large-eared Pied Bat); ‣ Yellow Box (*E. melliodora*) (Little Lorikeet, Superb Parrot, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Grey-Crowned Babbler, Diamond Firetail, Large-eared Pied Bat); ‣ *Angophora floribunda* (Little Lorikeet); ‣ Blakely's Red Gum (*E. blakelyi*) (Superb Parrot, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Grey-Crowned Babbler, Diamond Firetail, Large-eared Pied Bat); ‣ rough-barked species (Brown Treecreeper, Varied Sittella); ‣ River Red Gum (*E. camaldulensis*) (Superb Parrot, Brown Treecreeper, Squirrel Glider, Corben's Long-eared Bat, Little Pied Bat); ‣ Western Grey Box (*E. microcarpa*) (Superb Parrot, Black-chinned Honeyeater); ‣ smooth-barked gum species (Black-chinned Honeyeater, Varied Sittella); ▪ Plant *Acacia* tree species (Spotted Harrier, Little Eagle, Barking Owl, Brown Treecreeper, Painted Honeyeater, Squirrel Glider and Little Pied Bat) ▪ Plant Allocasurina/ Casurina species (Little Eagle, Barking Owl, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater)	The RMP and BMP will: ▪ include the planting (in appropriate soil landscapes) of a variety of box, ironbark and gum eucalypt species which are all known to occur in the Leard State Forest and biodiversity offset areas, and may include: ▪ White Box (Eucalyptus *albens*); ▪ Yellow Box (*E. melliodora*); ▪ *Angophora floribunda* (Rough-barked Apple); ▪ Blakely's Red Gum (*E. blakelyi*) ▪ Dwyer's Red Gum (*E. dwyeri*) ▪ River Red Gum (*E.* camaldulensis); ▪ Western Grey Box (*E. microcarpa*) ▪ Include the planting of *Acacia* species, including both tree and shrub varieties including tree varieties. ▪ Include the planting of *Allocasuarina* / *Casuarina* species ▪ Include the planting of *Melaleuca* species ▪ Describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create structurally diverse habitat.
	3b. Lack of suitable ground cover (Spotted Harrier, Turquoise Parrot, Brown Treecreeper, Speckled Warbler, Hooded Robin, Grey-crowned Babbler, Diamond Firetail) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Plant native grasses. ▪ Plant native herbs (Turquoise Parrot, Diamond Firetail). ▪ Plant native forbs (Grey-crowned Babbler). ▪ Correct spacing for species when planting seedlings.	▪ The RMP and BMP will include the planting of a variety of native grasses, herbs and forbs. ▪ The RMP will provide application rates for seeds as well as planting densities for tube stock.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
	3c. Dense shrub layer (Brown Treecreeper) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Correct spacing for species when planting seedlings.	▪ The RMP will provide application rates for seeds as well as planting densities for tube stock.
	3d. Poor floristic diversity (Koala) (Department of Environment and Climate Change, 2008a; OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Control for floristic diversity be means of planting a high number of both eucalypt and non-eucalypt species.	▪ The RMP and BMP will aim to include a wide diversity of species in the seed mix.
4. Remnant Area and Ecological Connectivity The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform will over time increase the size of the existing vegetation patches.	4a. Small patch area size (Barking Owl, Speckled Warbler,, Brown Treecreeper Black-chinned Honeyeater, Grey-crowned Babbler, Squirrel Glider) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Increase woodland patch area within biodiversity offset areas. ▪ Increase woodland patch area in mine rehabilitation area.	▪ The BMP will focus on increasing woodland patch size within the offset area and aim to enhance ecological connectivity.
5. Structural Diversity The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform, together with the salvage and re-use of woody debris, hollows and bush rock, will over time provide a range of suitable habitats for threatened fauna species.	5a. Lack of dead stumps or fallen timber (Turquoise Parrot, Barking Owl, Brown Treecreeper, Speckled Warbler, Hooded Robin, Diamond Firetail) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities (Condition 36 Schedule 3 of Project CoA). ▪ Restriction on firewood collection (OEH, 2015). ▪ Place nest boxes and/ or hollow limbs in young eucalypt trees without hollows in particular:	▪ The BMP will not permit firewood collection. ▪ The RMP and BMP will describe procedures to reuse woody debris/ hollow logs salvaged during vegetation clearing activities (consistent with Condition 36 Schedule 3 of Project CoA), including placement of hollow limbs or artificial hollows in some select trees without hollows.
	5b. Lack of tree hollows (Pale-headed Snake, Squirrel Glider, Superb Parrot, Brown Treecreeper, Yellow-bellied Sheathtail-bat, Corben's Long-eared Bat, Little Pied Bat, Eastern False Pipistrelle) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.		
6. Feral Animals The BMP will describe procedures to monitor, prevent and control feral animals in the restoration and rehabilitation phase of the project.	6a. Predation by feral animals including foxes, cats and dogs (Turquoise Parrot, Speckled Warbler, Koala) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Undertake feral predator control.	▪ The RMP and BMP will describe procedures to prevent, monitor and control feral animals including foxes, cats and dogs
	6b. Disturbance to roosting sites by feral goats and pigs (Eastern Cave Bat, Large-eared Pied Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Monitoring and control feral pigs and goats (Eddy, 2002; Rawlings *et al.* 2010).	▪ As above.
7. Weeds The RMP and BMP will describe procedures to prevent, monitor and control weeds. They will also describe relevant targets and performance indicators for weed management.	7a. Invasion of weeds, resulting in loss of important food plants (Diamond Firetail) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Weed control (Condition 49 Schedule 3 of Project CoA).	▪ The BMP will detail a weed management strategy, including relevant targets and performance indicators for weed management (Condition 49 Schedule 3 of Project CoA).
	7b. Loss of food sources or indirect poisoning as a results of use of pesticides, insecticides or herbicides (Spotted Harrier, Little Eagle, Masked Owl, Yellow-bellied Sheathtail-bat,	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Limit use of pesticides used in suitable native habitat (OEH, 2015). ▪ Use herbicides sparingly (minimised through spot-spraying, basal spraying, stem injection or cut and	▪ The BMP will detail methods for the safe use pesticides and herbicides (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
	Eastern Bentwing-bat, Corben's Long-eared Bat, Large-eared Pied Bat, Little Pied Bat, Eastern False Pipistrelle, Eastern Cave Bat) (OEH, 2015)		paint application methods) (DSE, 2005; Rawlings *et al.* 2010; DECCW, 2010.	
8. Regeneration The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform, together with the salvage and re-use of woody debris, hollow logs and bush rock, will over time provide a range of suitable habitats for threatened fauna species.	8a. Poor regeneration of habitat (Turquoise Parrot, Speckled Warbler, Brown Treecreeper, Black-chinned Honeyeater, Diamond Firetail, Hooded Robin, Barking Owl, Little Lorikeet, Swift Parrot, Squirrel Glider, Koala, Pale-headed Snake) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Encourage regeneration by fencing (OEH, 2015). ▪ Undertake new plantings (OEH, 2015), ▪ Reduce intensity of grazing (OEH, 2015).	▪ Encouraging regeneration of native fauna habitat is an aim of the RMP and BMP through measures such as fencing, planting and grazing management.
9. Management	9a. Too frequent grazing management (Spotted Harrier, Turquoise Parrot, Masked Owl, Barking Owl, Brown Treecreeper, Speckled Warbler, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Hooded Robin, Grey-crowned Babbler, Varied Sittella, Diamond Firetail, Large-eared Pied Bat, Eastern Cave Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Fencing of areas undergoing revegetation to exclude grazing livestock and prevent grazing of seedlings (Eddy, 2002). ▪ Maintenance of fencing used to exclude livestock. ▪ Restriction of livestock access to maintain ground cover. ▪ Low stocking rates.	▪ The RMP and BMP will describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ The BMP will describe management of livestock to maintain ground cover and diversity of native plants.
	9b. Too frequent burning management (Pale-headed Snake, Square-tailed Kite, Masked Owl, Barking Owl, Speckled Warbler, Koala, Large-eared Pied Bat, Eastern Cave Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ No controlled burns whilst vegetation is establishing. ▪ Assess fuel loads. ▪ DECCW (2010) suggests fire frequency should be a minimum interval of 5 years and a maximum interval of 40 years. Rawlings et al. (2010) recommends fire frequency in patches should be every 4 to 8 years. ▪ Controlled burns should be undertaken in a mosaic (i.e. retain some unburned areas (DECCW, 2010).	▪ The BMP and Biodiversity Offset Strategy will prescribe bushfire management strategies for rehabilitation of post-mine landforms and biodiversity offset areas respectively.

F4 Existing fauna habitats in the BOAs

F4.1 Broad fauna habitat types

The BOAs have been extensively studied during development of the Biodiversity Offset Strategy, and more recently during inspections undertaken between 13 - 17 August 2012 and 23 March 2015 to 10 April 2015 to assist in preparation of the BMP.

The following broad fauna habitat types have been recorded in the BOAs, as outlined in Table F-4 and illustrated in each specific BOA Management Plan (Appendix E).

Grassy woodland on fertile soils

The Grassy Woodland on Fertile Soils habitat type occurs as stands of low to moderately disturbed vegetation on the mid to lower slopes and flats of the properties, with relatively low exotic species cover (refer Table F-4). The canopy cover averages 12.7%, reflecting the natural woodland structure within this habitat. The Grassy Woodland on Fertile Soils habitat in the BOAs provides a relatively high density of hollow-bearing trees (22 per ha) with numerous hollows providing nesting opportunities for birds, nesting dens for arboreal mammals and roosting habitat for microchiropteran bats. A diverse ground cover of grasses together with forbs and sedges are present, which is reflected in the high average native species diversity (34.5) recorded. Decorticating bark (*E. albens*) and fallen timber (327 m/ ha) provide microhabitat features for certain reptiles and birds.

Shrubby woodland/ open forest on skeletal soils

The Shrubby Woodlands/ Open Forest on Skeletal Soils habitat type occurs predominately as undisturbed stands of vegetation on the mid to upper slopes of the BOAs. The average exotics species cover (1.3%) is generally very low throughout this habitat type. Canopy cover averages16.3% and is dominated by the species *E. albens* and *E. crebra* with sub-dominate and sub-canopy species (in parts) including *E. dwyeri* and *Callitris glaucophylla*.

This habitat contains a relatively high density of hollow-bearing trees (22 per ha) with numerous hollows providing nesting opportunities for birds, nesting dens for arboreal mammals and roosting habitat for microchiropteran bats. A diverse shrub and ground cover of grasses and forbs is present, which is reflected in the high average native species diversity (38.5). Fallen timber is prevalent throughout the Shrubby Woodlands/ Open Forest on Skeletal Soils habitat type (527 m/ha) with some vegetation types containing in excess of 600 m/ ha. These resources provide important microhabitat features for certain reptiles and birds.

This habitat type also contains large areas of rocky cliff lines and caves potentially suitable for roosting microchiropteran bats (refer Table F-1).

Table F-4 Management zones, fauna habitat types and corresponding vegetation communities

Management zone	Fauna habitat	Vegetation community	Plant Community Type	Biodiversity Offset Area	Threatened species
Habitat management	Grassy woodland on fertile soils	White Box grassy woodland	▪ White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [NA226, PCT 1383] ▪ Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion – (grassy variant) [NA197, PCT1118]	▪ Namoi ▪ Merriendi ▪ Wirrilah ▪ Mallee ▪ Myall Plains ▪ Nioka North ▪ Sunshine ▪ Braefield	▪ Raptors: Little Eagle, Square-tailed Kite, Spotted Harrier ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella ▪ Blossom nomads: Little Lorikeet, Swift Parrot, Regent Honeyeater ▪ Superb Parrot ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider, Koala ▪ Pale-headed Snake
		Weeping Myall Woodland EEC	▪ Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [NA219, PCT27]	▪ Namoi ▪ Merriendi	▪ Raptors: Little Eagle, Square-tailed Kite, Spotted Harrier ▪ Forest owls: Barking Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Hooded Robin, Painted Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella ▪ Superb Parrot
		Pilliga Box – Poplar Box – White Cypress Pine grassy open woodland	▪ Pilliga Box – White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [NA179, PCT88]	▪ Namoi	▪ Raptors: Little Eagle, Square-tailed Kite, Spotted Harrier ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella ▪ Blossom nomads: Little Lorikeet, Swift Parrot, Regent Honeyeater ▪ Superb Parrot ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider, Koala ▪ Pale-headed Snake
		Belah alluvial woodlands	▪ Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region [NA102, PCT55] ▪	▪ Namoi	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Hooded Robin, Painted Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella ▪ Mammals: Spotted-tailed Quoll
		Yellow Box Blakely's Red gum grassy woodland	▪ Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [NA237, PCT1329]	▪ Mallee ▪ Nioka North ▪ Braefield	▪ Raptors: Little Eagle, Square-tailed Kite, Spotted Harrier ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella ▪ Blossom nomads: Little Lorikeet, Swift Parrot, Regent Honeyeater ▪ Superb Parrot ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider, Koala ▪ Pale-headed Snake

Management zone	Fauna habitat	Vegetation community	Plant Community Type	Biodiversity Offset Area	Threatened species
	Shrubby woodland/ open forest on skeletal soils	Dwyer's Red Gum woodland	▪ Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [NA245, PCT610]	▪ Namoi ▪ Merriendi ▪ Wirrilah ▪ Mallee ▪ Nioka North ▪ Sunshine	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Speckled Warbler, Turquoise Parrot, Painted Honeyeater, Diamond Firetail, Varied Sittella ▪ Mammals: Spotted-tailed Quoll
		White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	▪ Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [NA165, PCT1381]	▪ Namoi ▪ Merriendi ▪ Goonbri ▪ Wirrilah ▪ Myall Plains ▪ Mallee ▪ Nioka North ▪ Sunshine	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Brown Treecreeper, Grey-crowned Babbler, Speckled Warbler, Hooded Robin, Diamond Firetail, Varied Sittella ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider ▪ Pale-headed Snake
		Silver-leaved Ironbark heathy woodland	▪ White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion [NA224, PCT1307]	▪ Namoi ▪ Goonbri ▪ Myall Plains ▪ Nioka North ▪ Sunshine	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Grey-crowned Babbler, Speckled Warbler, Varied Sittella ▪ Mammals: Spotted-tailed Quoll
		Rough - barked Apple - White Box Shrubby Woodland	▪ White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	▪ Namoi ▪ Mallee ▪ Nioka North ▪ Sunshine	▪ Raptors: Little Eagle ▪ Forest owls: Barking Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Grey-crowned Babbler, Speckled Warbler, Varied Sittella ▪ Blossom nomads: Little Lorikeet ▪ Mammals: Spotted-tailed Quoll
		White Pine/Narrow Leaved Ironbark Shrub/Grass Open Forest	▪ White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [NA228, PCT1313]	▪ Namoi ▪ Wirrilah ▪ Myall Plains ▪ Mallee	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Speckled Warbler, Varied Sittella ▪ Mammals: Spotted-tailed Quoll ▪ Pale-headed Snake
		Regrowth - White Cypress Pine	▪ Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [NA165, PCT1381]	▪ Merriendi ▪ Namoi ▪ Wirrilah	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella
		White Box - Blakely's Red Gum - Rough-barked Apple Shrubby Woodland (shrubby variant)	▪ Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	▪ Sunshine	▪ Raptors: Little Eagle ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Hooded Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella

Management zone	Fauna habitat	Vegetation community	Plant Community Type	Biodiversity Offset Area	Threatened species
					▪ Blossom nomads: Little Lorikeet, Swift Parrot, Regent Honeyeater ▪ Mammals: Spotted-tailed Quoll, Koala ▪ Pale-headed Snake
	Riverine woodland	River Red Gum Riparian woodland and open forest	▪ River Red Gum riparian tall woodland/ open forest wetland in the Nandewar and Brigalow Belt South Bioregion [NA193, PCT78]	▪ Namoi	▪ Raptors: Little Eagle, Square-tailed Kite, Spotted Harrier ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Grey-crowned Babbler, Speckled Warbler, Varied Sittella ▪ Blossom nomads: Little Lorikeet ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider ▪ Pale-headed Snake
		White Box – Melaleuca riverine forest	▪ River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [NA191, PCT84]	▪ Namoi ▪ Braefield	▪ Raptors: Little Eagle, Square-tailed Kite, Spotted Harrier ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Grey-crowned Babbler, Speckled Warbler, Varied Sittella ▪ Blossom nomads: Little Lorikeet, Swift Parrot, Regent Honeyeater ▪ Superb Parrot ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider, Koala ▪ Pale-headed Snake
		Myrtle Shrubland (+- White Pine/Tumbledown Red Gum); Dripping Rock	▪ Cypress pine – Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [NA410, PCT427]	▪ Mallee	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Grey-crowned Babbler, Speckled Warbler, Varied Sittella ▪ Mammals: Spotted-tailed Quoll
		Rough Barked Apple Riparian Forbs/Grassy Forest	▪ Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	▪ Mallee	▪ Raptors: Little Eagle, Square-tailed Kite ▪ Forest owls: Barking Owl, Masked Owl ▪ Microchiropteran bats: hollow-dwelling and cave dwelling ▪ Woodland birds: Turquoise Parrot, Grey-crowned Babbler, Speckled Warbler, Varied Sittella ▪ Superb Parrot ▪ Mammals: Spotted-tailed Quoll, Squirrel Glider ▪ Pale-headed Snake
	Grassland	Plains Grassland CEEC	▪ Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [NA181, PCT102]	▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
Habitat restoration	Derived Grasslands	White Box grassy woodland (low condition), and White Box-White Cypress Pine grassy woodland (low condition)	▪ White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [NA226, PCT 1383] ▪	▪ Namoi ▪ Merriendi ▪ Goonbri ▪ Wirrilah ▪ Myall Plains ▪ Mallee ▪ Nioka North ▪ Sunshine	▪ Raptors: Little Eagle, Spotted Harrier

Management zone	Fauna habitat	Vegetation community	Plant Community Type	Biodiversity Offset Area	Threatened species
				▪ Braefield	
		White Box–White Cypress Pine grassy woodland (low condtion)	▪ White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [NA226, PCT 1383] (derived native grassland)	▪ Merriendi ▪ Myall Plains ▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		Yellow Box – Blakely's Red Gum grassy woodland (low condition)	▪ Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [NA237, PCT1329] (derived native grassland)	▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		River Red Gum Riparian woodland and forest (low condition)	▪ River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion [NA336, PCT438] (derved native grassland)	▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		White Box-Narrow-leaved Ironbark-White Cypress Pine srubby open forest (low condition)	▪ Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [NA165, PCT1381] (derived native grassland)	▪ Mallee ▪ Myall Plains ▪ Wirrilah ▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west (low condition)	▪ White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [NA228, PCT1313] (derived native grassland)	▪ Mallee ▪ Myall Plains ▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		Belah alluvial woodlands (low condition)	▪ Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region [NA102, PCT55]	▪ Merriendi ▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		Pilliga Box – Poplar Box – White Cypress Pine grassy open forest (low condition)	▪ Pilliga Box – White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [NA179, PCT88] (derived native grassland)	▪ Merriendi ▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		Silver-leaved Ironbark heathy woodland (low condition)	▪ White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion [NA224, PCT1307] (derived native grassland)	▪ Nioka North ▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier
		Dwyers Red Gum woodland (low condition)	▪ Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [NA245, PCT610] (derived native grassland)	▪ Namoi	▪ Raptors: Little Eagle, Spotted Harrier

Riverine woodland

The Riverine Woodland habitat type occurs principally along the Namoi River and major drainage lines, such as Bolar and Mi Hi Creeks. While many of the gully lines and drainage lines in the locality were dry during field surveys, the Namoi River and its floodplain contained flowing water and wetlands respectively.

Riverine Woodlands along the Namoi River contain the highest levels of disturbances with significant incursion of exotic weeds and pests. The riparian zone of the Namoi River contains senescent River Red Gums in an otherwise modified agricultural landscape. However, River Red Gums provide significant densities of hollow-bearing trees (31 per ha) and fallen timber (290 m/ ha) for a range of birds, roosting habitat for microchiropteran bats and possible dens for arboreal mammals. In addition to the hollow resources, this habitat type contains a number of small to medium sized natural soaks, which provide important natural water sources for a range of woodland birds and other fauna, including the threatened Black-necked Stork (refer Table F-1).

Within the smaller riparian habitats along minor streams of the BOAs the condition of this habitat type is significantly less disturbed. These areas generally contain low levels of exotic species, and high native species diversity within a natural structure. In particular, riparian habitat in the northwest of Nokia North, which are associated with MI Hi Creek are of very high value.

Grassland

The majority of the Grassland habitats within the BOAs comprise moderate condition derived native grasslands with high native diversity and low exotic weed incursions. However, these areas have been disturbed from grazing and other agricultural practices that have removed native overstorey and groundcover vegetation.

This habitat includes the natural grassland community (Plains Grassland) and higher quality areas of Derived Grassland associated with more recent clearing.

Within grassland habitats, isolated paddock trees can play an important role by providing habitat to a range of fauna and maintaining connectivity between larger patches of vegetation (Department of Environment and Climate Change 2008b). Moreover, this habitat type provides foraging resources for a range of species in the form of seeds, insects and rodents.

F4.2 Condition of fauna habitats in the BOAs

The condition of the fauna habitats, whilst variable, has been observed to be in generally good condition due to the high number of native species and low weed densities. Importantly, all of the fauna habitats within the BOAs contain similar native species diversity to the habitats within the Project Boundary. The per cent canopy cover is also comparable for the majority of the habitat types between the BOAs and Project Boundary. Only the Shrubby Woodland/ Open Forest on Skeletal Soils habitat type has been recorded as having a reduced per cent canopy cover within the BOAs, which is likely to reflect the presence of heathy vegetation where the canopy layer was naturally low.

Native regeneration and shrub cover is slightly lower within the BOAs when compared to the Project Boundary. However, such attributes are likely to improve through restoration as detailed in the main BMP document and BOA Management Plans (Appendix E).

Hollow-bearing tree resources and fallen timber are two microhabitats critical for ecological processes, breeding resources for fauna and overall habitat condition. The BOAs contain a relatively high density of hollow-bearing trees, with surveys indicating a similar or greater abundance in comparison to the Project Boundary.

F4.3 Attributes of fauna habitat types in the BOAs

Habitat attributes of the four habitat types recorded in the Project Boundary and BOAs are presented in Table F-5. The distribution of threatened species within the BOAs is detailed in Table F-6. Table F- 7 outlines the potential habitat quality available in restoration zones for each targeted threatened species. Table F-8 describes predicted threatened species uptake in each BOA based on restoration age.

Table F-5 Attributes of fauna habitats in the Project Boundary and BOAs

Fauna habitat	No. of sample sites		Native species diversity		Avg. canopy cover (%)		Avg. shrub cover (%)		Native canopy regen. (%)[1]		Hollow trees (ha)[2]		Fallen timber (m/ha)[3]		Avg. exotic species (%)	
	Project Boundary	BOAs	Project Boundary	BOAs	Project Boundary	BOAs	Project Boundary	BOAs	Project Boundary	BOAs	Project Boundary	BOAs	Project Boundary	BOAs	Project Boundary	BOAs
Grassy Woodland on Fertile Soils	28	27	32.5	34.5	10.5	12.7	14.4	7.3	70	30	18.3	22	323	327	16.2	10.3
Shrubby Woodlands/ Open Forest on Skeletal Soils	29	43	34	38.5	22.5	16.25	19.2	4.72	100	50	11.5	22	543.4	527	0.2	1.33
Riverine Woodland	4	7	22	33.9	27.4	30.61	18	10.3	100	50	12.5	31	156.3	290	51.5	44
Grassland	1	15	20	27	6	1	6	3.9	100	20	10	7	50	115	4	18.3

Attributes detailed in Table F-5 correspond to averaged BioBanking plot data collected within the Project Boundary and Biodiversity Offset Areas for each fauna habitat type.

(1) Native canopy regeneration (%) is measured as the proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height <5 cm.
(2) Hollow trees (ha) equates to a living or dead tree that has at least one hollow. A tree is considered to contain a hollow if:
the entrance can be seen
the minimum entrance width is at least 5 cm across
the hollow appears to have depth.
(3) Fallen timber (m/ha).

Table F-6 Distribution of threatened species in the Project Boundary and BOAs

Common name	Boggabri Coal Mine Project Boundary	BOAs									
		Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine	Braefield	Goonbri	Jerralong
Barking Owl	R	P	P	P	P	R	P	P	P	P	P
Black-chinned Honeyeater	R	P	P	P	P	P	R	P	P	P	P
Black-necked Stork	R	N	N	N	P	N	N	N	N	N	P
Brown Treecreeper	R	R	R	R	R	R	R	R	R	P	P
Diamond Firetail	R	R	R	P	R	P	R	P	P	P	P
Eastern Bent-wing Bat	R	R	R	R	R	P	P	P	P	P	P
Eastern Cave Bat	R	R	R	R	R	R	P	P	P	P	P
Eastern False Pipistrelle	R	R	R	R	P	P	P	P	P	P	P
Corben's Long-eared Bat	R	P	P	R	R	P	R	P	P	P	P
Grey-crowned Babbler	R	R	R	R	R	R	R	P	R	P	R
Hooded Robin	R	R	R	R	R	P	P	P	R	P	P
Koala	R	P	P	R	R	P	P	P	P	P	P
Large-eared Pied Bat	R	P	P	P	P	P	R	P	P	P	P
Little Eagle	R	R	R	R	N	R	P	P	P	P	P
Little Lorikeet	R	R	R	R	R	R	R	R	P	P	P
Little Pied Bat	R	P	P	P	R	P	P	P	P	P	P
Masked Owl	R	P	R	P	R	P	P	P	P	P	P
Painted Honeyeater	R	P	P	P	R	R	P	P	P	P	P
Pale-headed Snake	R	P	P	P	P	P	P	P	P	P	P
Pied Honeyeater	P	P	P	P	P	P	P	P	P	P	P

Common name	Boggabri Coal Mine Project Boundary	BOAs									
		Mallee	Merriendi	Myall Plains	Namoi	Wirrilah	Nioka North	Sunshine	Braefield	Goonbri	Jerralong
Regent Honeyeater	P	P	P	P	P	P	P	P	P	P	P
Speckled Warbler	R	R	R	R	R	R	R	R	R	P	P
Spotted Harrier	R	P	P	P	R	P	P	P	P	P	P
Spotted-tailed Quoll	P	P	P	P	P	P	P	P	P	P	P
Square-tailed Kite	R	P	P	P	P	P	P	P	P	P	P
Squirrel Glider	P	R	P	R	P	P	R	P	P	P	P
Superb Parrot	P	P	P	P	P	P	P	P	P	P	P
Swift Parrot	P	P	P	P	P	R	P	P	P	P	P
Turquoise Parrot	R	R	R	R	R	P	R	R	R	P	P
Varied Sittella	R	R	R	R	R	P	R	P	R	P	P
Yellow-bellied Sheathtail-bat	R	R	R	R	R	R	P	P	P	P	P

Note: (R) - Recorded, (P) - Moderate of greater likelihood of occurrence, (N) - Not recorded or predicted to occur.

Table F- 7 Habitat quality for threatened species in habitat restoration and corridor enhancement zones

General habitat features	Restoration age				
	5 years	10 years	15 years	20 years	30+ years
Vegetation characteristics					
Canopy Height[1]	4.5 meters	9 meters	13.5 meters	18 meters	>20 meters
Canopy cover[2]	10%	20%	30%	30%	30%
Understorey cover	22%	30%	30%	30%	30%
Blossom value[3]	Low	Moderate	High	High	High
Mistletoe presence	Absent	Absent	Present	Present	Present
Nest Box provision	0%	50%	50%	100%	100%
Ground timber provision[4]	0%	50%	50%	100%	100%
Habitat take-up by prey species	30%	50%	75%	100%	100%
Threatened species					
Little Eagle	Early shrub and tree growth, with fallen timber in an open mosaic produce hunting opportunities	Initial careful plant spacing provides continued open foraging areas	Open foraging areas with increased tree size provide foraging and nesting opportunities	Foraging and breeding habitat opportunities present	Foraging and breeding habitat opportunities present
Square-tailed Kite	Early shrub and tree growth, with fallen timber in an open mosaic produce passerine hunting opportunities	Increased shrub and tree maturity provides good passerine foraging areas	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging and increased tree maturity offering breeding locations	Foraging and breeding habitat opportunities present	Foraging and breeding habitat opportunities present
Barking Owl	Early shrub and tree growth, with fallen timber in an open mosaic produce hunting opportunities	Increased shrub and tree maturity provides increased passerine foraging areas	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging

General habitat features	Restoration age				
	5 years	10 years	15 years	20 years	30+ years
Masked Owl	Early shrub and tree growth, with fallen timber in an open mosaic produce hunting opportunities	Increased shrub and tree maturity provides increased passerine foraging areas	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging	Open mosaic structure with sufficient shelter as required by passerine prey represent foraging and breeding habitat opportunities present
Cave-dwelling Microchiropteran Bats	Foraging opportunities present.	Foraging opportunities present.	Foraging habitat opportunities present	Foraging habitat opportunities present	Foraging habitat opportunities present
Hollow-dependent Microchiropteran Bats	Foraging opportunities present.	Trunks of planted trees now of sufficient size to maintain nest boxes may be taken up.	Habitat usage established as canopy trees reach sufficient size. Nest box provision offering breeding opportunities	Habitat usage established as canopy trees reach sufficient size. Nest box provision offering breeding opportunities	Foraging and breeding habitat opportunities present
Turquoise Parrot	Early shrub and tree growth, with fallen timber produce sufficient increase in habitat complexity to offer safe foraging opportunities	Initial careful plant spacing provides open foraging areas with increased shelter offered by maturing plants.	Stabilised habitat usage as open foraging areas continue to exist in a mosaic woodland structure with established breeding territories.	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.
Brown Treecreeper	Increasing use of fallen timber within increasing open area buffer from existing vegetation through this period.	Trunks of planted trees now of sufficient size to represent foraging areas,	Continued increase in habitat usage approaching 100% with large areas of habitat representing part of defended territories.	100% of habitat being used for foraging with all habitats representing part of defended territories, Breeding events continue to occur in new habitat.	Continued usage of new habitat, first hollow potential hollow inspections by treecreepers
Hooded Robin	Early shrub and tree growth, with fallen timber produce sufficient increase in habitat complexity to offer safe foraging opportunities	Initial careful plant spacing provides open foraging areas with increased shelter offered by maturing plants.	Stabilised habitat usage as open foraging areas continue to exist in a mosaic woodland structure with established breeding territories.	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.
Black-chinned Honeyeater	Limited usage of habitat due to limitations on canopy values particularly on slow growing ironbarks	Limited usage of habitat due to limitations on canopy values particularly on slow growing ironbarks	Habitat representing foraging opportunities increasing with intermittent usage	Habitat representing foraging opportunities increasing with increased intermittent usage and breeding potential	Stabilised habitat usage with established breeding territories.

General habitat features	Restoration age				
	5 years	10 years	15 years	20 years	30+ years
Painted Honeyeater	Limited usage of habitat due to limitations on mistletoe take-up	Seasonal usage occurring due to mistletoes take up on suitable acacia species	Stabilised seasonal habitat usage In line with occurrences in locality with breeding territories established.	Stabilised seasonal habitat usage In line with occurrences in locality with breeding territories established.	Stabilised seasonal habitat usage In line with occurrences in locality with breeding territories established.
Pied Honeyeater	Limited usage of habitat due to limitations on canopy values particularly on slow growing ironbarks	Limited usage of habitat due to limitations on canopy values particularly on slow growing ironbarks	Habitat representing foraging opportunities increasing with intermittent usage	Habitat representing foraging opportunities increasing with increased intermittent usage and breeding potential	Stabilised habitat usage with established breeding territories.
Grey-crowned Babbler	Provision of open understory components and fallen timber provides secure foraging opportunities	Maturing tall shrubs and young trees providing nesting opportunities while open foraging opportunities continue to exist	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.
Speckled Warbler	Early take up of habitat, due to the fast growth of shrub layer plants such as acacia species.	Continued take up of habitat as initial short-lived shrubs mature and long-lived shrub types increase in size. Established breeding territories existing at this point	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.
Diamond Firetail	Early shrub and tree growth, with fallen timber produce sufficient increase in habitat complexity to offer safe foraging opportunities	Initial careful plant spacing provides open foraging areas with increased shelter offered by maturing plants. Habitat taken up by breeding pairs	Stabilised habitat usage as open foraging areas continue to exist in a mosaic woodland structure with established breeding territories.	Stabilised habitat usage with established breeding territories.	Stabilised habitat usage with established breeding territories.
Varied Sittella	Limited usage of habitat due to limitations on canopy values	Habitat usage increasing as canopy trees increase in size	Habitat usage established as canopy trees reach sufficient size	Habitat usage established as canopy trees reach sufficient size trees of sufficient maturity to represent breeding opportunities	Stabilised habitat usage with breeding territories established.

General habitat features	Restoration age				
	5 years	10 years	15 years	20 years	30+ years
Little Lorikeet	Limited usage of habitat due to limitations on canopy values	Habitat usage increasing as canopy trees increase in size and maturity	Habitat usage established as canopy trees reach sufficient size. Nest box provision offering breeding opportunities	Habitat usage established as canopy trees reach sufficient size. Nest box provision resulting in breeding opportunities	Stabilised habitat usage with breeding occurrences regularly.
Swift Parrot	Limited habitat opportunities due to limitations on canopy values	Increased habitat opportunities due to increases on canopy values	Foraging opportunities present for seasonal use	Foraging opportunities present for seasonal use	Foraging opportunities present for seasonal use
Spotted Harrier	Early shrub and tree growth, with fallen timber in an open mosaic produce hunting opportunities	Initial careful plant spacing provides continued open foraging areas	Open foraging areas with increased tree size provide foraging and nesting opportunities	Foraging and breeding habitat opportunities present	Foraging and breeding habitat opportunities present
Black-necked Stork	Limited use	Limited use	Limited use	Potential habitat usage increasing with development of natural soaks along drainage lines, culverts	Potential habitat usage increasing with development of natural soaks along drainage lines, culverts
Superb Parrot	Limited usage of habitat due to limitations on canopy values	Habitat usage increasing as canopy trees increase in size	Habitat usage established as canopy trees reach sufficient size	Habitat usage opportunities	Stabilised habitat usage during seasonal occurrences in locality
Regent Honeyeater	Limited habitat opportunities due to limitations on canopy values	Increased habitat opportunities due to increases on canopy values	Foraging and breeding habitat opportunities present for seasonal use	Foraging and breeding habitat opportunities present for seasonal use	Foraging and breeding habitat opportunities present for seasonal use
Spotted-tailed Quoll	Limited usage of habitat due to limitations on canopy values	Foraging habitat opportunities present	Foraging habitat opportunities present	Foraging habitat opportunities present	Foraging habitat opportunities present
Squirrel Glider	Limited usage of habitat due to limitations on canopy values	Increased habitat opportunities due to increases on canopy values. Trunks of planted trees now of sufficient size to maintain nest boxes may be taken up.	Foraging and breeding habitat opportunities present	Foraging and breeding habitat opportunities present	Foraging and breeding habitat opportunities present

General habitat features	Restoration age				
	5 years	10 years	15 years	20 years	30+ years
Koala	Limited usage of habitat due to limitations on canopy values	Increased habitat opportunities due to increases on canopy values. Trunks of planted trees now of sufficient size to maintain foraging habitats.	Foraging habitat opportunities present	Foraging habitat opportunities present	Foraging habitat opportunities present
Pale-headed Snake	Limited use	Limited use	Limited use	Habitat usage opportunities	Continued usage of new habitat, first hollow potential

(1) Estimated height of canopy species
(2) Estimated canopy cover percentage based on BioBanking method for percentage foliage cover directly overhead
(3) Blossom value ranking is indicative of the quality of a flowering event to local and nomadic nectarivorous species (i.e. honeyeaters)
(4) Ground timber provision is calculated as the percentage installation based on hectare amount per relevant fauna habitat type.

Table F-8 Threatened species predicted in habitat restoration and corridor enhancement zones for each Biodiversity Offset Area

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
Merriendi	White Box – White Cypress Pine grassy woodland (low condition)	Spotted Harrier Little Eagle Speckled Warbler Hooded Robin Diamond Firetail	Spotted Harrier Little Eagle Speckled Warbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Masked Owl	Little Eagle Speckled Warbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Grey-crowned Babbler Masked Owl Yellow-bellied Sheathtaill-bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Grey-crowned Babbler Black-chinned Honeyater Barking Owl Masked Owl Yellow-bellied Sheathtaill-bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Grey-crowned Babbler Black-chinned Honeyeater Barking Owl Masked Owl Yellow-bellied Sheathtaill-bat Eastern False Pipistrelle
	Belah alluvial woodlands (low condition)	Spotted Harrier Little Eagle Grey-crowned Babbler	Spotted Harrier Little Eagle Grey-crowned Babbler Speckled Warbler	Little Eagle Grey-crowned Babbler Speckled Warbler Painted Honeyeater Yellow-bellied Sheathtaill-bat Eastern False Pipistrelle	Little Eagle Grey-crowned babbler Speckled Warbler Painted Honeyeater Turquoise Parrot Diamond Firetail Varied Sittella Hooded Robin Masked Owl Barking Owl	Little Eagle Grey-crowned babbler Speckled Warbler Painted Honeyeater Turquoise Parrot Diamond Firetail Varied Sittella Hooded Robin Masked Owl Barking Owl

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
					Yellow-bellied Sheathtaill-bat	Yellow-bellied Sheathtaill-bat
					Eastern False Pipistrelle	Eastern False Pipistrelle
	Pilliga Box – Poplar Box – White Cypress Pine grassy open forest (low condition)	Spotted Harrier	Spotted Harrier	Little Eagle	Little Eagle	Little Eagle
		Little Eagle	Little Eagle	Speckled Warbler	Speckled Warbler	Speckled Warbler
		Speckled Warbler	Speckled Warbler	Little Lorikeet	Little Lorikeet	Little Lorikeet
				Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned Babbler
				Diamond Firetail	Diamond Firetail	Diamond Firetial
				Yellow-bellied Sheathtaill-bat	Hooded Robin	Hooded Robin
					Brown Treecreeper	Brown Treecreeper
				Eastern False Pipistrelle	Varied Sittella	Varied Sittella
					Turquoise Parrot	Turquoise Parrot
					Barking Owl	Barking Owl
					Masked Owl	Masked Owl
					Yellow-bellied Sheathtaill-bat	Yellow-bellied Sheathtaill-bat
					Eastern False Pipistrelle	Eastern False Pipistrelle
Namoi	White Box – White Cypress Pine grassy woodland (low condition)	Spotted Harrier	Spotted Harrier	Little Eagle	Little Eagle	Little Eagle
		Little Eagle	Little Eagle	Speckled Warbler	Speckled Warbler	Speckled Warbler
		Speckled Warbler	Speckled Warbler	Diamond Firetail	Diamond Firetail	Diamond Firetail
		Grey-crowned Babbler	Grey-crowned Babbler	Little Lorikeet	Little Lorikeet	Little Lorikeet
				Turquoise Parrot	Turquoise Parrot	Turquoise Parrot
				Brown Treecreeper	Brown Treecreeper	Brown Treecreeper
				Varied Sittella	Varied Sittella	Varied Sittella
				Grey-crowned babbler	Grey-crowned babbler	Grey-crowned babbler

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
				Yellow-bellied Sheathtail-bat	Black-chinned Honeyeater	Black-chinned Honeyeater
				Eastern Cave Bat	Masked Owl	Masked Owl
				Eastern False Pipistrelle	Yellow-bellied Sheathtail-bat	Yellow-bellied Sheathtail-bat
					Eastern Cave Bat	Eastern Cave Bat
					Eastern False Pipistrelle	Eastern False Pipistrelle
	White Pine/Narrow-leaved Ironbark shrub/grass open forest (low condition)	Little Eagle	Little Eagle	Little Eagle	Little Eagle	Little Eagle
		Speckled Warbler	Speckled Warbler	Speckled Warbler	Speckled Warbler	Speckled Warbler
		Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned Babbler
				Turquoise Parrot	Turquoise Parrot	Turquoise Parrot
				Varied Sittella	Varied Sittella	Varied Sittella
				Hooded Robin	Hooded Robin	Hooded Robin
				Diamond Firetail	Diamond Firetail	Diamond Firetail
					Barking Owl	Barking Owl
					Masked Owl	Masked Owl
	River Red Gum riparian woodland and forest (low condition)	Spotted Harrier	Spotted Harrier	Little Eagle	Little Eagle	Little Eagle
		Little Eagle	Little Eagle	Little Lorikeet	Little Lorikeet	Little Lorikeet
			Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned babbler
				Yellow-bellied Sheathtail-bat	Barking Owl	Barking Owl
					Masked Owl	Masked Owl
				Eastern Cave Bat	Yellow-bellied Sheathtail-bat	Yellow-bellied Sheathtail-bat
				Eastern False Pipistrelle	Eastern Cave Bat	Eastern Cave Bat
					Eastern False Pipistrelle	Eastern False Pipistrelle
	Pilliga Box – Poplar Box – White Cypress	Spotted Harrier	Spotted Harrier	Spotted Harrier	Spotted Harrier	Spotted Harrier

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
	Pine grassy open forest (low condition)	Little Eagle	Little Eagle	Little Eagle	Little Eagle	Little Eagle
		Grey-crowned Babbler	Grey-crowned Babbler	Grey-crowned Babbler	Speckled Warbler	Speckled Warbler
			Speckled Warbler	Speckled Warbler	Little Lorikeet	Little Lorikeet
				Diamond Firetail	Grey-crowned Babbler	Grey-crowned Babbler
					Diamond Firetail	Diamond Firetial
					Hooded Robin	Hooded Robin
					Brown Treecreeper	Brown Treecreeper
					Varied Sittella	Varied Sittella
					Turquoise Parrot	Turquoise Parrot
					Barking Owl	Barking Owl
					Masked Owl	Masked Owl
					Yellow-bellied Sheathtaill-bat	Yellow-bellied Sheathtaill-bat
					Eastern False Pipistrelle	Eastern False Pipistrelle
	Belah alluvial woodlands (low condition)	Spotted Harrier	Spotted Harrier	Little Eagle	Little Eagle	Little Eagle
		Little Eagle	Little Eagle	Grey-crowned Babbler	Grey-crowned babbler	Grey-crowned babbler
		Speckled Warbler	Speckled Warbler	Speckled Warbler	Speckled Warbler	Speckled Warbler
		Grey-crowned Babbler	Grey-crowned Babbler	Painted Honeyeater	Painted Honeyeater	Painted Honeyeater
				Yellow-bellied Sheathtaill-bat	Turquoise Parrot	Turquoise Parrot
					Diamond Firetail	Diamond Firetail
				Eastern False Pipistrelle	Varied Sittella	Varied Sittella
					Hooded Robin	Hooded Robin
					Barking Owl	Barking Owl
					Yellow-bellied Sheathtaill-bat	Yellow-bellied Sheathtaill-bat
					Eastern False Pipistrelle	Eastern False Pipistrelle

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
Wirrilah and Goonbri	White Box – White Cypress Pine grassy woodland (low condition)	Spotted Harrier Little Eagle Speckled Warbler Grey-crowned Babbler	Little Eagle Speckled Warbler Grey-crowned Babbler	Little Eagle Speckled Warbler Grey-crowned Babbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Grey-crowned Babbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Grey-crowned Babbler Hooded Robin Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle
	White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (low condition)	Spotted Harrier Little Eagle Speckled Warbler Grey-crowned Babbler	Little Eagle Speckled Warbler Grey-crowned Babbler	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot Varied Sittella Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Grey-crowned babbler Turquoise Parrot Varied Sittella Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot Varied Sittella Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle
Myall Plains	White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby	Little Eagle Speckled Warbler	Little Eagle Speckled Warbler	Little Eagle Speckled Warbler	Little Eagle Speckled Warbler	Little Eagle Speckled Warbler

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
	open forest (low condition)	Turquoise Parrot Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Turquoise Parrot Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Grey-crowned Babbler Turquoise Parrot Brown Treecreeper Diamond Firetail Little Lorikeet Varied Sittella Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Grey-crowned Babbler Turquoise Parrot Brown Treecreeper Diamond Firetail Little Lorikeet Varied Sittella Black-chinned Honeyeater Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Grey-crowned Babbler Turquoise Parrot Brown Treecreeper Little Lorikeet Diamond Firetail Varied Sittella Black-chinned Honeyeater Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern False Pipistrelle
	White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west (low condition)	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot Varied Sittella	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot Varied Sittella	Little Eagle Speckled Warbler Grey-crowned Babbler Turquoise Parrot Varied Sittella
Mallee	White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (low condition)	Little Eagle Speckled Warbler Turquoise Parrot	Little Eagle Speckled Warbler Turquoise Parrot	Little Eagle Brown Treecreeper Speckled Warbler Turquoise Parrot Diamond Firetail Hooded Robin Varied Sittella Yellow-bellied Sheathtail-bat	Little Eagle Brown Treecreeper Speckled Warbler Turquoise Parrot Diamond Firetail Hooded Robin Varied Sittella Barking Owl	Little Eagle Brown Treecreeper Speckled Warbler Turquoise Parrot Diamond Firetail Hooded Robin Varied Sittella Barking Owl

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
				Eastern Cave Bat Eastern False Pipistrelle	Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle	Yellow-bellied Sheathtail-bat Eastern Cave Bat Eastern False Pipistrelle
Nioka North	White Box grassy woodland (low condition)	Little Eagle Speckled Warbler	Little Eagle Speckled Warbler	Little Eagle Speckled Warbler Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Hooded Robin Grey-crowned Babbler Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Hooded Robin Grey-crowned Babbler Black-chinned Honeyeater Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Little Eagle Speckled Warbler Diamond Firetail Little Lorikeet Turquoise Parrot Brown Treecreeper Varied Sittella Hooded Robin Grey-crowned Babbler Black-chinned Honeyeater Yellow-bellied Sheathtail-bat Eastern False Pipistrelle
Sunshine	White Box grassy woodland (low condition	Little Eagle	Little eagle Speckled Warbler	Little Eagle Speckled Warbler Turquoise Parrot Little Lorikeet	Little Eagle Speckled Warbler Turquoise Parrot Little Lorikeet Brown Treecreeper Varied Sittella	Little Eagle Speckled Warbler Turquoise Parrot Little Lorikeet Brown Treecreeper Varied Sittella
Braefield	White Box grassy woodland (low condition)	Speckled Warbler Turquoise Parrot	Speckled Warbler Turquoise Parrot	Speckled Warbler Turquoise Parrot	Speckled Warbler Turquoise Parrot	Speckled Warbler Turquoise Parrot

BOA	Vegetation description	Restoration age (years)[1]				
		5	10	15	20	30+
			Yellow-bellied Sheathtatil-bat Eastern False Pipistrelle	Brown Treecreeper Diamond Firetail Hooded Robin Little Lorikeet Varied Sittella Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Brown Treecreeper Little Lorikeet Varied Sittella Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern False Pipistrelle	Brown Treecreeper Little Lorikeet Varied Sittella Barking Owl Masked Owl Yellow-bellied Sheathtail-bat Eastern False Pipistrelle

(1) Threatened species predicted based on habitat attributes estimated for each restoration age in Table F-7.

F5 Generic actions for long-term maintenance of suitable habitat for threatened biodiversity

The majority of threatened biodiversity values recorded or predicted to occur in the locality of the Project are generally affected by similar threatening processes, including the clearing of woodland resulting in the fragmentation of habitat, modification and destruction of terrestrial microhabitats (i.e. removal of litter and fallen timber) (Department of Environment and Conservation 2006b; Reid 1999; Trail & Duncan 2000).

In order for the protection and long-term maintenance of suitable habitat for threatened species and ecological communities, the following briefly describes the relevant steps necessary to ensure their longevity in the locality:

- purchase strategic biodiversity offsets to enable protection, rehabilitation and long-term maintenance of the East-West Wildlife Corridor
- maintain a 500 m corridor between Boggabri Coal and Maules Creek Coal Mine to facilitate adequate corridor (buffer zone) and movement of species between the mines and also along the East-West Wildlife Corridor
- provide protection to areas of existing high quality vegetation (habitat management zones)
- rehabilitate areas of derived native grassland and agricultural land to supplement habitat management areas and form an integral part of providing an adequate East-West Wildlife Corridor
- complement rehabilitation activities with supplementary fauna microhabitats, including fallen timber and nest boxes
- monitor each BOA as part of the annual Biodiversity Monitoring Program (refer Section 7.2 of the main BMP document).

The following sections describe how suitable habitat will be protected and restored within each of the offset management zones. The extent of each zone within the BOAs is provided in Table F-9.

Table F-9 Extent of offset management zones in each BOA

BOA	Management zones (ha)			
	Habitat management	Habitat restoration	Corridor enhancement	Other lands for Agricultural
Mallee	2,025.9	40.3	0.0	0.0
Merriendi	327.0	156.2	0.0	0.0
Myall Plains	367.4	62.0	43.9	0.0
Namoi[1]	1,563.4	1,391.4	30.3	229.8
Wirrilah	326.8	371.8	185.6	0.0
Sunshine	353.2	300.1	84.7	0.0
Nioka North	523.1	316.6	17.9	0.0

BOA	Management zones (ha)			
	Habitat management	Habitat restoration	Corridor enhancement	Other lands for Agricultural
Goonbri	127.6	88.3	15.1	0.0
Jerralong	222.4	300.8	0.0	46.9
Braefield	1,283.2	117.1	0.4	0.0
Total	**7,120.0**	**3,144.6**	**377.9**	**276.7**

(1) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine (Figure 1-2 of the main BMP). Boggabri Coal owns 50% of land purchased under the joint venture agreement.

F5.1 Habitat management zone

The habitat management zone is associated with remnant native woodland vegetation in good condition, with limited disturbances and exotic species present. This zone requires some active pest and weed management activities, fencing of areas adjoining lands not managed for biodiversity conservation and the exclusion of livestock grazing. These areas are generally considered to not require any assisted revegetation and provide existing high quality fauna habitats.

Specific management actions within each BOA are provided in the BOA Management Plans (Appendix E).

F5.2 Habitat restoration zone

The habitat restoration zone incorporates those areas of good condition native grassland communities with only moderate exotic species present and an existing soil seed bank with the potential for natural revegetation. Management activities within this zone involve fencing, targeted pest and weed management and supplementary canopy planting to facilitate enhanced revegetation of the canopy layer. This zone will also incorporate the provision of supplementary habitat features to further encourage use by local fauna species.

F5.3 Corridor enhancement Zone

The corridor enhancement zone incorporates those areas of non-native grasslands that have been significantly disturbed by past land use practices, including clearing, cropping, pasture improvement and heavy grazing. This zone incorporates supplementary canopy planting and some targeted weed and pest management activities to increase woody canopy cover and build on adjoining existing wildlife corridors. This zone is likely to further encourage the use of the proposed wildlife corridors by semi mobile fauna species in the medium to long-term.

F6 Implementation Plan for Box Gum Woodlands

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a Critically Endangered ecological community under the EPBC Act. White Box Yellow Box Blakely's Red Gum Woodland is listed as an endangered ecological community under the BC Act.

Several vegetation communities that occur within the Project boundary have been identified as being commensurate with both the federal and state listing of Box Gum Woodlands and would be directly affected by the proposed mine expansion and rail corridor. These include the following:

- Yellow Box –Blakely's Red Gum grassy woodland
- White Box – White Cypress Pine grassy woodland
- White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest.

This ecological community occurs along the western slopes and tablelands of the Great Dividing Range from southern Queensland through NSW to central Victoria (Threatened Species Scientific Committee 2006). It is generally found on moderate to highly fertile soils on tablelands and the western slopes of NSW (NSW Scientific Committee 2002). The canopy layer is dominated by one or more of *Eucalyptus albens* (White Box) *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). Vegetation communities where the canopy layer of the aforementioned eucalypts has been removed and the grassy native understorey is present are also considered to be included as the threatened community in both the federal and state listings. Therefore, the structure of this community can be variable from grassy woodland to derived grasslands and the structure will often reflect past land use practices. In western NSW, the community intergrades with *Eucalyptus microcarpa* (Western Grey Box) or *Eucalyptus moluccana* (Grey Box) without the three aforementioned canopy trees present. The federal listing includes these vegetation assemblages as part of the Critically Endangered Community, where they occur within the Nandewar Bioregion only. The dominant understorey species of herbs and grasses vary across the range of the community due to latitudinal and climatic conditions. However, *Themeda australis* (Kangaroo Grass) and *Poa sieberiana* (Snow Grass) were originally dominant across a large part of the community's range, however these species are sensitive to grazing pressure and have declined in recent years (Cole & Lunt 2005).

F6.1 Distribution of Box Gum Woodlands

Box Gum Woodlands have been mapped as occupying an area of approximately 3,214 ha within the Leard State Forest (James B. Croft and Associates 1983) and approximately 633 ha of this ecological community will be cleared for the Project. Box Gum Woodlands are widespread on the fertile flats in the Project Boundary and BOAs (refer Table F-10).

F6.2 Threats

The main threats that affect Box Gum Woodlands in the Project Boundary and BOAs include:

- clearing, degradation and fragmentation of remnants for agricultural, forestry, infrastructure and residential development

- continuous heavy grazing and trampling of remnants by grazing stock, resulting in losses of plant species (simplification of the understorey and ground layer and suppression of overstorey), soil compaction, erosion and other soil changes (including increased/decreased nutrient status)
- invasion of remnants by non-native plant species, including noxious weeds, pasture species and environmental weeds, including garden escapes, olives and pines
- invasion of remnants by feral animals resulting in the loss or modification of habitat
- disturbance and clearance of remnants during agricultural, road, rail and infrastructure maintenance and upgrades
- harvesting of firewood (either living or standing dead, including material on the ground) and bush rock
- collection of on-ground woody debris in the guise of a 'clean-up'
- instability and poor drainage of the final landform
- poor soil quality – insufficient soil depth, poos water holding capacity, insufficient topsoil depth, lack of soil mycorrhizae
- insufficient seed bank in soil.

F6.3 Recovery actions

The following recovery actions have been identified by the OEH for Box Gum Woodland EEC across NSW:

- identification of key sites for protection and management
- prepare management plans for top priority sites
- target priority weeds for control
- delineate and protect areas with fencing or signage
- determine optimal management techniques for restoring degraded remnants
- research and utilise techniques where agricultural practices are integrated successfully with conservation
- identify methods for controlling particular introduced species identified as significantly threatening
- develop guidelines for identification and assessment of remnant quality
- collate survey and mapping information and use towards production of integrated and updatable maps
- control Coolatai grass in high-quality remnants of Box Gum Grassy Woodland
- monitor effects of Coolatai Grass invasion in high-quality remnants of Box Gum Grassy Woodland.

F6.4 Maintenance of Box Gum Woodlands

A key element of the monitoring within the BOAs is to determine the condition of White Box Woodland remnants in accordance with the State and Transition model for box gum grassy woodlands. The State and Transition model is a way to think about the condition of woodland, how it got to be that way, and what changes are possible with management actions. The baseline survey will be used to delineate the vegetation within the BOAs into States as follows:

- State 1: Grassy woodland
- State 2: Native pastures and woodland
- State 3: Fertilised pastures
- State 4: Crops and sown pastures
- State 5: Revegetated areas.

Using the State and Transition model during the monitoring of the BOAs, any transition from a state can be detected and hence the effectiveness of management actions can be gauged. Each habitat management zone below is allocated to a state according to the state and transition model for box gum woodlands.

Habitat management zone

BOAs currently provide approximately 3,487.6 ha of management zones containing Box Gum Woodlands (Table F-10). Of this, 1,527.9 ha are of high quality State 1 Box Gum Woodland.

Table F-10 Extent of Box Gum Woodland within the Habitat Management and Restoration Zones of each BOA

Box Gum Woodland[1]	Habitat in offset properties (ha)										Combined total habitat in offset areas (ha)
	Merriendi	Namoi	Jerralong[2]	Goonbri	Wirrilah	Myall Plains	Mallee	Nioka North	Sunshine	Braefield	
Habitat management zone (State 1 Woodland)	176.1	326.4	0	72.3	146.1	66.5	14.2	291.5	240.5	194.3	1,527.9
Habitat restoration zone (State 2: native pastures)	150.5	590.1	0	88.3	517.5	43.9	0	265.2	248.8	55.4	1,959.7
Combined total habitat	**326.6**	**916.5**	**0**	**160.6**	**663.6**	**110.4**	**14.2**	**556.7**	**489.3**	**249.7**	**3,487.6**

(1) Box Gum Woodland State 4 (crops and sown pastures) and State 5 (revegetated areas) do not occur within the BOAs.
(2) Box Gum Woodland does not occur within the the Jerralong BOA.

Habitat Restoration Zone

In the medium to long-term it is estimated that an additional 1,959.7 ha of habitat restoration will supplement the 1,527.9 ha of existing Box Gum Woodland within habitat management zones and effectively contribute to the viability of a local and regional wildlife corridor and maintenance of Box Gum Woodlands in the locality.

In the short-term, early shrub and tree growth, supplemented with fallen timber will likely provide sufficient habitat complexity to afford safe foraging opportunities for a range of species. Over the longer term, structural complexity of mature woodland will provide a full range of foraging and breeding opportunities for fauna.

Management measures for maintenance of Box Gum Woodland

The main threats affecting Box Gum Woodlands involve direct loss. Therefore, the most important management measure in the short-term is the protection of existing habitat management zones in the BOAs, including the restricted access of site personnel and the general public, particularly concerning the removal of standing dead trees for fire wood. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction on the fauna component of the community, by potentially allowing those displaced individuals (from established breeding territories) to relocate to other habitat areas in the immediate vicinity of the Project Boundary. Management measures for Box Gum Woodland include:

- fencing
- grazing management for conservation
- weed and pest control
- fire management for conservation
- management of human access and disturbance
- retention or addition of habitat features
- nutrient management
- erosion control
- thinning
- revegetation.

F6.5 Management actions and performance criteria

Table F-11 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of Box Gum Woodland.

Table F-11 Management actions and performance criteria for Box Gum Woodland

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as other lands for agriculture Incorporate appropriate signage on boundary fencing	Short to long term – ongoing Fences installed by year 10 and maintained as required	Appropriate wildlife fencing installed and/or maintained around BOA boundaries, where appropriate. Appropriate locks and signage is maintained in good legible condition and designated access roads and tracks are maintained in order to prevent unauthorised access. Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as other lands for agriculture	Short to long term Fences installed by year 10 and maintained as required	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.

Objective	Management zone	Management action	Timing	Performance criteria
Biodiversity monitoring	Habitat management and habitat restoration	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document) If after a rehabilitation age of 5 years canopy regeneration has not significantly taken affect (i.e. not evident or at required density), then supplementary planting would commence at a density approximate to analogue sites.	Short to long term	Annual biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1. BOA Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs met at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.
Habitat use	Habitat management	Complete annual biodiversity monitoring (refer Section 7.2 of the main BMP document)	Short to long term	Annual monitoring of diurnal bird and microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Habitat Management Zones show no observed significant decrease (i.e. greater than 40 % reduction sustained over three consecutive sampling periods) in bird species richness across the BOAs that cannot be attributed to natural variation against baseline monitoring site data.
Medium-term				

Objective	Management zone	Management action	Timing	Performance criteria
Canopy regrowth	Habitat restoration and corridor enhancement	Actively manage areas of restoration Complete inspections of habitat restoration zones on a five yearly basis to determine success of naturally regenerating and planted canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites.	5 year 10 year 15 year	Evidence of canopy growth in Box Gum Woodland restoration zones compared to baseline assessment and milestones nominated in Table F-7. At least 350 ha of Box Gum Woodland DNG across all BOAs are actively being restored back to Box Gum Woodland (refer to BOS and Appendix E of mian BMP document) for locations and areas of Box Gum Woodland DNG to be restored). Naturally regenerated areas of Box Gum Woodland conform to condition assessment outlined on page five of the EPBC Policy Statement 3.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands within the Habitat Restoration Zones. 100% of Box Gum Woodland BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

Objective	Management zone	Management action	Timing	Performance criteria
Canopy recruitment	Habitat restoration	Actively manage areas of restoration Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites	5 year 10 year 15 year	100% of Box Gum Woodland BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. 100% of Box Gum Woodland BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting for example *Eucalyptus albens* and/or *Eucalyptus melliodora*. Given monitoring is undertaken in accordance with BBAM 2014 sampling for natural regeneration is to occur across the entire vegetation zone.
Habitat use	Habitat restoration	Complete annual biodiversity monitoring (refer Section 7.2 of the main BMP document)	Short to long term	Annual monitoring of diurnal bird and microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Habitat Restoration Zones and Corridor Enhancement Zones show an observed increase in bird species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in Section 7.1.1). Threatened bird species occupancy and habitat usage continues.

Objective	Management zone	Management action	Timing	Performance criteria
Provision of artificial/ supplementary habitat suitable for breeding	Habitat restoration and corridor enhancement	Incorporate nest boxes in restoration areas until natural generation of tree hollows predominate	Medium term	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F-7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F-7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.

Objective	Management zone	Management action	Timing	Performance criteria
Provision of supplementary habitat	Habitat restoration and corridor enhancement	Incorporation of ground timber in restoration areas	10 years 15 years	Provision of ground timber as per criteria detailed in Table F-7: • 50 % of ground timber to be incorporated from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate withi criteria detailed in Table F-7. • 100 % of ground timber to be incorporated from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7.
Long-term				
Ecosystem health	Habitat restoration and corridor enhancement	Actively manage areas of restoration	20 years 30+ years	100% of Box Gum Woodland BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. 100% of Box Gum Woodland at BOA monitoring locations within the Habitat Restoration Zones show locally occurring canopy species recruiting for example *Eucalyptus albens* and/or *Eucalyptus melliodora*. Given monitoring is undertaken in accordance with BBAM 2014 sampling for natural regeneration is to occur across the entire vegetation zone.

Objective	Management zone	Management action	Timing	Performance criteria
Ecosystem structure	Habitat restoration and corridor enhancement	Actively manage areas of restoriation	20 years 30+ years	Annual biodiversity monitoring undertaken in accordance with Section 7.2 of the main BMP document to measure the success of restoration and maintenance of Box Gum Woodland against BBAM 2014 benchmark data and analogue sites within Habitat Management Zones. Monitoring to include photograph point monitoring. 100% of Box Gum Woodland BOA monitoring sites within Habitat Restoration Zones area within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark following active revegetation. Salvaged resources are reused and relocated to rehabilitated areas and BOA Habitat Restoration Zones and are in structurally good condition.

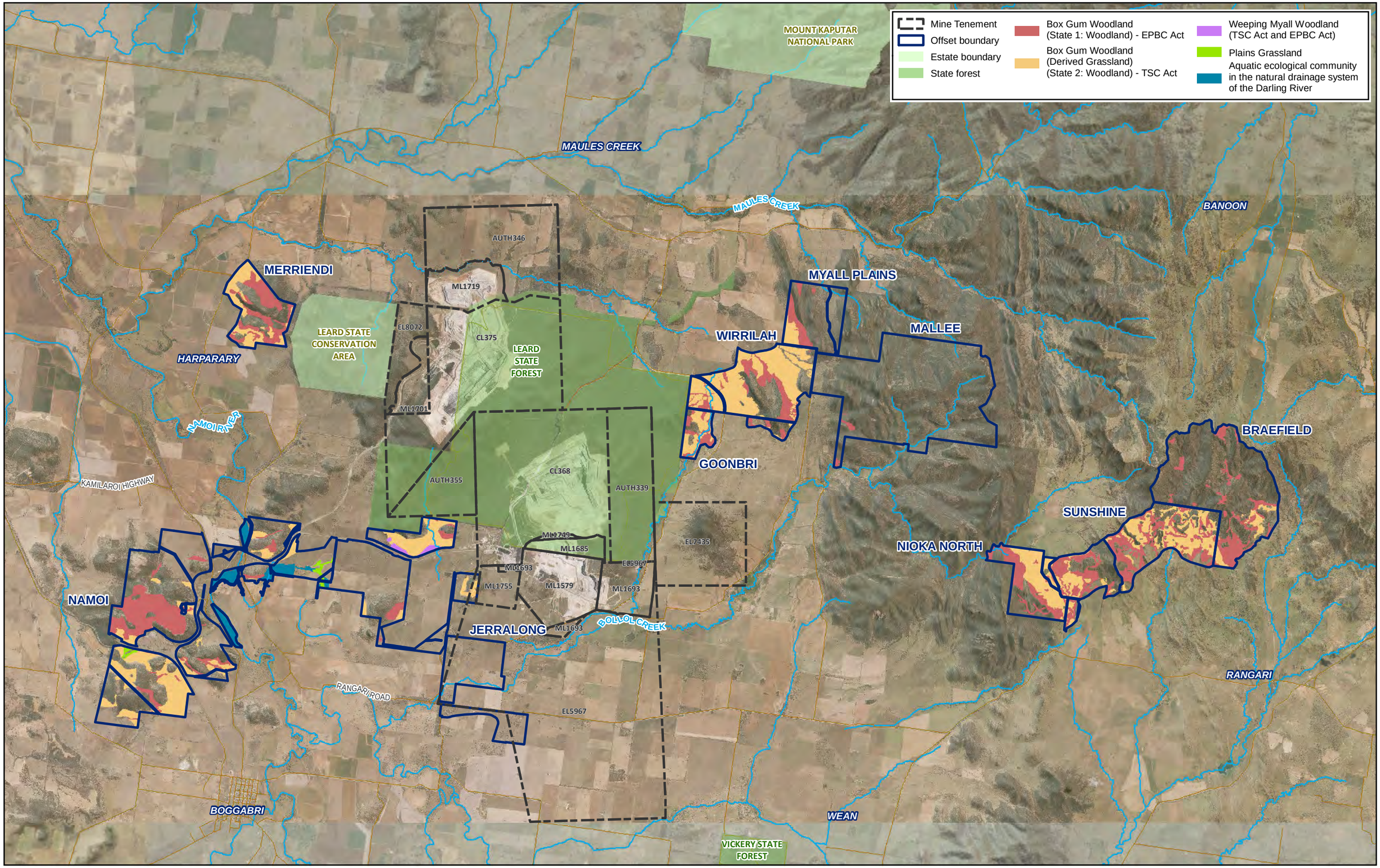
Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring	20 years 30+ years	Annual monitoring of diurnal bird and microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Habitat Restoration Zones and Corridor Enhancement Zones show an observed increase in bird species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document). Threatened bird species occupancy and habitat usage.

Objective	Management zone	Management action	Timing	Performance criteria
Control of weed species	All management zones[1]	Implement integrated weed management	Annual	Annual BOA Biodiversity Monitoring Report shows an overall reduction in exotic plant cover following implementation of control measures across all BOAs. Weed species within native vegetation communities comprise less than 20% of any strata across the BOAs within 10 years of control measures being implemented. Cypress Pine and Shiny Bush thinning undertaken across BOAs. Endeavour to achieve the following targets: • Reduced to less than 80% of original distribution by end of year 5 • Reduced to less than 50% of original distribution by end of year 10 • Reduced to less than 30% of original distribution by end of year 15 • Maintenance thinning to occur in years following initial thinning events. Weed control undertaken in accordance with the relevant practises and guidelines specified in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new weed infestations are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification, where applicable.

Objective	Management zone	Management action	Timing	Performance criteria
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads.	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)
Control of pest species, particularly foxes, cats and goats	All management zones[1]	Complete strategic culling events or baiting programs as necessary	>2 years	Documentation detailing the use of any pest control activity, required efficacy and the results of any program instigated Annual BOA Biodiversity Monitoring Report shows an overall reduction in pest animal species and population sizes targeted by control measures implemented across all management zones across all BOAs (taking into consideration potential drought conditions and seasonal trends). Pest animal control is undertaken in accordance with relevant Codes of Practise and Standard Operating Procedures as detailed in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new pest occurrences are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification, where applicable.

Objective	Management zone	Management action	Timing	Performance criteria
Implement fire regime for conservation	Habitat management	Undertake strategic burns in a fire regime aimed at promoting patchiness to promote diversity	Autumn Every 4 to 8 years in each patch as necessary	Reduction in weed species in BOAs Promotion of species diversity in BOAs
Nutrient management	Habitat restoration	Restrict stock access (crash grazing) Change, reduce or eliminate fertiliser use in adjacent or upslope paddocks Create buffers that capture nutrients before they enter the patch Hay cutting Topsoil removal (scalping) Seeding (Kangaroo Grass, Snow Tussock, Red Grass)	Before revegetation	Nutrient loads are reduced across all BOAs i.e. all fertilisers and other soil amelioration measures associated with agriculture have ceased and livestock grazing excluded. Only soil improvement measures and crash grazing required for revegetation/regeneration as well as fuel load and weed management of native vegetation communities to occur. Annual BOA Biodiversity Monitoring Report shows an overall reduction in weed species (such as broadleaf weeds and annual pasture grasses) following reduction of fertiliser use across all BOAs. Weed species within native vegetation communities comprise less than 20% of any strata across the BOAs.

(1) Notes: 1. Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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AUTHOR.	Suansrir
CHECKED BY.	N.Cooper
DATE.	3/12/2018

APPENDIX. F-1

TITLE. BOX GUM WOODLAND

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F7 Threatened raptors

The Little Eagle and Square-tailed Kite have been assessed together based on their similarities in habitat use and susceptibility to impacts associated with the Project.

F7.1 Threatened species profiles

Little Eagle – *Hieraaetus morphnoides*

The Little Eagle is listed as Vulnerable under BC Act. The Little Eagle is distributed throughout most of the Australian mainland, except in the most densely forested parts of the Great Dividing Range escarpment (NSW Scientific Committee 2009a), with adults being sedentary (to partly migratory in autumn-winter) and young being dispersive (Pizzey & Knight 2007). The Little Eagle occupies plains, foothills, open eucalypt forest and woodland or open woodland, while acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993). This species builds a large stick nest in tall living trees within remnant patches of vegetation and generally breeds from July to October, and earlier in the south (Pizzey & Knight 2007). The diet of the Little Eagle generally consists of terrestrial mammals, birds and reptiles (NSW Scientific Committee 2009a).

Over 50% of forest and woodlands in NSW have been cleared (Lunney 2004), thus, the main threat that affects this species is the further clearing and degradation of foraging and breeding habitat (NSW Scientific Committee 2009a). On the NSW tablelands and western slopes, important habitat is 53–84% cleared and moderately to highly stressed (NSW Scientific Committee 2009a). Loss of breeding sites may bring this species into increasing interspecific competition with the larger and more dominant Wedge-tailed Eagle.

Square-tailed Kite – *Lophoictinia isura*

The Square-tailed Kite (Debus *et al.* 1993) is listed as a Vulnerable species under the BC Act. This raptor is endemic to Australia and is widespread throughout the mainland, although it is sparsely distributed (Marchant and Higgins 1993). The species is recorded along coastal and sub-coastal areas, from south-western to northern Australia, Queensland, NSW and Victoria. Scattered records throughout NSW indicate that the species is a regular resident along the major west-flowing river systems. This species is also migratory throughout its range and is a summer breeding migrant to south-eastern and south-western Australia. The Square-tailed Kite inhabits open forests, woodlands with particular preference for timbered watercourses. Within NSW, the species is often associated with ridge and gully forests containing *Eucalyptus longifolia* (Woollybutt), *E. maculata* (Spotted Gum) *E. elata* (River Peppermint) and *E. smithii* (Ironbark Peppermint), as well as forests containing Angophora and Callitris and Box-Ironbark woodland.

The Square-tailed Kite occupies large home ranges, in the order of 100 square kilometres, and is specialist hunter of passerines (particularly honeyeaters) and foliage insects, with most prey taken from the outer foliage of the tree canopy (NSW National Parks and Wildlife Service 1999b). Breeding occurs from July to February with an average clutch size of three eggs. Nest sites are generally located near watercourses in a fork or large horizontal branches of eucalypts or Angophora tree species.

Except when breeding, this species tends to be a solitary bird, usually seen hunting alone high in, or just above the tree canopy in coastal or sub-coastal rainforest, forest or woodland.

Nests have been reported in *Eucalyptus* spp., *Angophora* spp. and native pine forests. Prey taken has included fledging birds, insects, rabbits and lizards.

Over 50% of forest and woodlands in NSW have been cleared (Lunney 2004), thus, the main threat that affects this species is the further clearing and degradation of foraging and breeding habitat (NSW National Parks and Wildlife Service 1999b).

F7.2 Distribution of Little Eagle and Square-tailed Kite

The Little Eagle has been recorded on several occasions within the Project Boundary and BOAs (refer Table F-6). Figure F-2 shows the spatial distribution of Parsons Brinckerhoff observations. The Square-tailed Kite has anecdotally been recorded over Leard State Forest.

F7.3 Threats

The main threat to the Little Eagle and Square-tailed Kite is inferred to be the clearing, burning, grazing, and degradation of foraging and breeding habitat. As the Little Eagle is a resident, territorial species that is long lived with low reproductive output, recent declines in areas that formerly had low and stable populations may be attributable to a long-term process of the reduction and degradation of habitat quality.

Key threats to the Little Eagle and Square-tailed Kite are detailed in (Table F-12).

Table F-12 Threats to threatened raptors

Species	Threat
Little Eagle	▪ Secondary poisoning from rabbit baiting ▪ Clearing and degradation of foraging and breeding habitat
Square-tailed Kite	▪ Clearing, burning and grazing of habitats resulting in a reduction in nesting and feeding resources ▪ Disturbance to or removal of potential nest trees near watercourses ▪ Illegal egg collection and shooting

Any pest animal control plan utilising baiting considered for action in the Project Boundary and BOAs (particularly for the control of rabbits) will need to consider the required efficacy offset against this species. Recent sightings and potential home ranges of Little Eagle should be considered in the planning of pest control events.

Furthermore, Little Eagle typically preys on terrestrial mammals, birds and reptiles. Due to the decline of rabbits (following the spread of rabbit calicivirus disease), this species is increasingly dependent on native prey, with much of its former native mammalian prey of inland NSW being extinct, including bandicoots, bettongs and hare-wallaby. Remaining native prey such as quail require appropriate groundcover, thus are sensitive to habitat degradation from grazing (NSW Scientific Committee final determination).

F7.4 Recovery actions

The following applicable recovery actions (Table F-13) have been identified by NSW OEH for threatened raptors Little Eagle and Square-tailed Kite:

Table F-13: Threats to threatened raptors

Raptor	Recovery action
Little Eagle	▪ Protect and maintain high quality habitat, which consists of open forest and woodland with a mosaic of open and timbered areas, including wooded farmland, gallery forests and wooded floodplains along water courses and around wetlands. Riparian areas are particularly important. Where possible negotiate conservation agreements with landholders, agreements should preferably be funded and in perpetuity. ▪ Improve prey availability through restoration of degraded remnants, particularly riparian areas. Increase structural complexity and species diversity in understorey through the control of invasive exotic plants, the removal of thick swards of exotic pasture grasses, management of grazing pressure and potentially augmentation planting with locally appropriate native species. ▪ Undertake revegetation, using a diverse mix of locally appropriate native species, and ensuring the creation of a mosaic of open and wooded areas. Revegetation should focus on expanding areas of existing small (less than 10 ha) habitat patches, particularly riparian habitat and creating wooded habitat patches around tall isolated trees. ▪ Increase the abundance of paddock trees, particularly large ones, by protecting existing trees, and supplementary planting or protection of natural regrowth. ▪ Utilise alternative poisons (such as 1080 or coumatetralyl) and control techniques such as warren ripping.
Square-tailed Kite	▪ Retain large trees in riparian areas and connectivity of remnant woodland patches ▪ Identify active nest sites and ensure that these sites are not disturbed during the breeding season (August-November) - by restricting access and activities within a 20m buffer ▪ Undertake restoration and revegetation of remnant woodland (prey habitat) patches within 20km of known active nest sites, focusing on patches that are or could be larger than 200ha once connected, to increase the area of structurally diverse woodland for foraging.

F7.5 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat is currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality. Habitat types of particular importance for these species include the Riverine Woodland and Grassy Woodland on Fertile Soils, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor. While the Little Eagle and Square-tailed Kite are not necessarily affected by the effects of habitat fragmentation, they are susceptible to the effects of habitat loss and degradation. In the medium to long-term, 3,522.5 ha of habitat restoration and corridor enhancement will likely provide important foraging and breeding habitat in the locality.

Management measures for maintenance of suitable habitat

The Square-tailed Kite is migratory throughout its range and inhabits open forest and woodlands with particular preference for timbered watercourses. Furthermore, this species is a regular resident along major west-flowing river systems with the Namoi River corridor meeting ecological requirements for this species, particularly as nest sites are generally located near watercourses.

Therefore, in the long-term a mature restoration of approximately seven kilometres of Riverine Woodland along the Namoi River is likely to provide important foraging and potential breeding habitat for this species in the locality. Furthermore, as preferred prey is generally taken from the outer foliage of the tree canopy, restoration of wildlife corridor (largely back to Grassy Woodland on Fertile Soils and Riverine Woodland) will provide potential foraging opportunities for this species in a largely cleared landscape.

Existing Riverine Woodland along the Namoi River supports large senescent *E. camaldulensis* (River Red Gum), which provide potentially suitable breeding locations. As large trees are not likely to occur in restoration areas for a period greater than 50 years, the maintenance of existing important habitat characteristics (large senescent trees) is critical for the appropriate restoration of the Namoi River floodplain.

The restoration of derived native grassland areas through regeneration of the existing soil seed bank is likely to provide limited habitat opportunities in the short to medium-term (e.g. 5-15 years), with increased usage thereafter as canopy trees increase in size and maturity.

Therefore, management measures particularly concern the effective restoration of the Grassy Woodland on Fertile Soil and Riverine Woodland habitat types across the BOAs. The restoration of derived native grassland through regeneration of the existing soil seed bank (supplemented by further planting of canopy species) will provide important habitat for these species in the locality. Furthermore, the structural elements for the continued survival of these species in the locality will be strengthened with the establishment of regional wildlife corridor networks.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to threatened raptors and will be implemented within each BOA:

- active and passive revegetation
- selective thinning
- retention and addition of habitat features for prey species
- management of unauthorised access and disturbance.

F7.6 Management actions and performance criteria

Table F-14 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for threatened raptors.

Table F-14 Management actions and performance criteria for threatened raptors

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and large trees capable of providing suitable nest locations	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as other lands for agriculture zone Incorporate appropriate signage on boundary fencing	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs as detailed in Appendix E Upgrade fencing around land designated as other lands for agriculture zone	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities.	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Biodiversity monitoring	All management zones[1]	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.

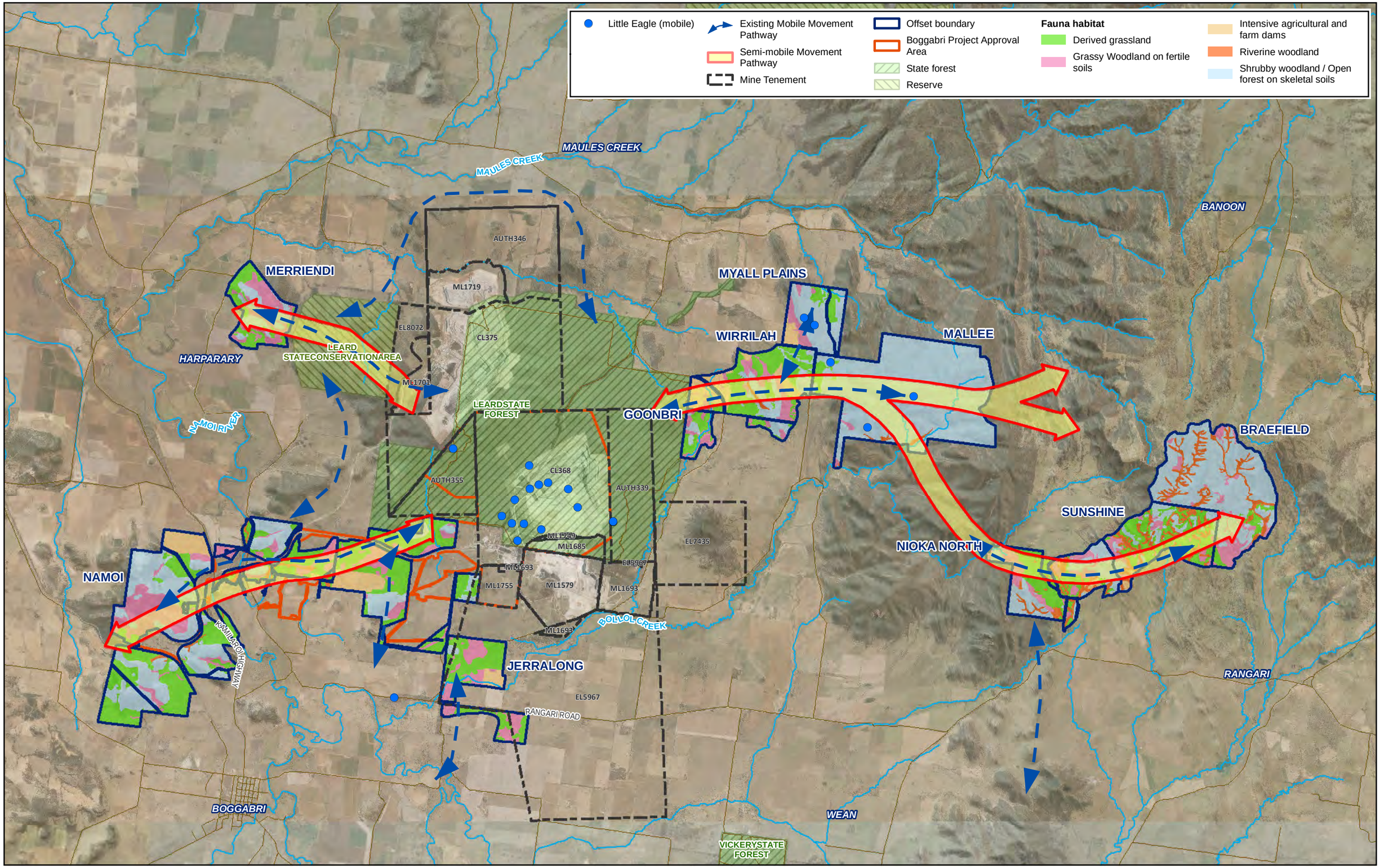
Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat management	Annual biodiversity monitoring and opportunistic sightings (refer Section 8.1 of the main BMP document)	Annual	Monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat Management Zones show no observed significant decrease (i.e. greater than 40 % reduction sustained over three consecutive sampling periods) in bird species richness across the BOAs that cannot be attributed to natural variation against baseline monitoring site data. Continued records for Little Eagle within BOAs.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for Little Eagle. Woodlands to contain areas of mid-storey shrubby trees and low shrubs to provide cover for small passerines and provide foraging habitat for Square-tailed Kite.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration. Inspections of habitat restoration and corridor enhancement zones are to be completed on a five yearly basis to determine success of naturally regenerating and planted canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in Habitat Restoration Zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for Little Eagle. Woodlands to contain areas of mid-storey shrubby trees and low shrubs to provide cover for small passerines and provide foraging habitat for Square-tailed Kite.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F-7. 100% of BOA monitoring sites within Habitat Restoration Zones area within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark following active revegetation.

Objective	Management zone	Management action	Timing	Performance criteria
Provision of habitat for prey species (Little Eagle only)	Habitat management	Incorporation of ground timber in restoration areas	10 years 15 years	Provision grounf timber as per criteria detailed in Table F-7: • 50 % of ground timber to be incorporated from a restoration age of 10 years, or when regenerating canopy species are commensurate with milestones detailed in Table F-7. • 100 % of grounf timber to be incorporated from a restoration age of 15 years, or when regenerating canopy species are commensurate with milestones detailed in Table F-7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Little Eagle and Square-tailed Kite	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring	>5 years	Observations of Little Eagle utilising areas of restoration where canopy species are commensurate with milestones detailed in Table F- 8. Provision of annual biodiversity offset monitoring report detailing threatened species records.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-2

TITLE. THREATENED RAPTORS

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F8 Threatened owls

The Barking Owl and Masked Owl have been assessed together as they generally share similar habitat requirements and threats that affect their recovery.

F8.1 Threatened species profiles

Barking Owl - *Ninox connivens*

The Barking Owl is listed as Vulnerable under the BC Act.

Barking Owls inhabit eucalypt woodland, open forest, swamp woodlands, and especially in inland areas, timber along watercourses (Pizzey & Knight 1997). Dense vegetation is used occasionally for roosting. During the day this species roosts along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts (Higgins 1999).

Barking Owls feed on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals, such as smaller gliders, possums, rodents and rabbits, becoming important during breeding. Estimates of Barking Owl home ranges indicated that territories range from 30 ha to 200 ha and hunt 5 km from roosts (Higgins 1999). However, surveys in the Pilliga forests of western NSW (Kavanagh 2009) found that Barking Owl home ranges averaged approximately 2,000 ha. Regurgitated pellets also showed that prey items consisted of mostly birds, insects and some mammals.

Eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*), Red Box (*Eucalyptus polyanthemos*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Nest-hollow entrances are 2 m to 35 m above the ground with a diameter of 20 cm to 46 cm and depth of 20 cm to 300 cm. Breeding occurs during late winter and early spring (NSW National Parks and Wildlife Service 2003).

Cluster analysis of records from NSW Wildlife Atlas within 300 km diameter around the Pilliga forests (Soderquist 2009) identified seven Barking Owl populations in the region of north-west NSW. The Pilliga population spreads to the Warrumbungle ranges and to the lower slopes of Mount Kaputar. While this population is an extensive one, no obvious lines of connectivity to other populations in the region were evident. Moreover, the gaps between these populations are generally wide expanses of mostly cleared habitat and without knowledge of juvenile dispersal ability, connectivity across the landscape cannot accurately be determined (Soderquist 2009).

Masked Owl - *Tyto novaehollandiae*

The Masked Owl is listed as Vulnerable under the BC Act.

Masked Owls are distributed mainly throughout NSW from the coast where it is most abundant to the western plains (NSW Scientific Committee 2004), where they inhabit a diverse range of wooded habitats including eucalypt forests, woodlands and almost treeless inland plains. Optimal habitat includes an open understorey and a mosaic of sparse and dense ground cover. Large hollows in live or occasionally dead eucalypts are used for roosting (Department of Environment and Conservation 2006a), but is also known to roost and nest in dense foliage in gullies and caves (Garnett & Crowley 2000).

Masked Owls typically prey on terrestrial mammals including rodents and marsupials but would also take other species opportunistically. Territories range 400 ha to 1000 ha and forages by hunting from perches at ecotones within forests and at forest edges (Kavanagh 1996).

Eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Nest-hollow entrances are at least three metres above the ground with a diameter greater than 40 cm and depth greater than 100 cm. Breeding mostly occurs during autumn and winter (NSW National Parks and Wildlife Service 2003).

F8.2 Distribution of Barking Owl and Masked Owl

Riverine Woodland and Grassy White Box Woodland on fertile soils within the Project Boundary and BOAs provide foraging resources and tree hollows suitable for breeding for both the Barking Owl and Masked Owl. Figure F-3 shows the spatial distribution of Parsons Brinckerhoff observations of these species in the Project Boundary and BOAs.

F8.3 Threats

The following threats (Table F-15) have been identified by NSW OEH for threatened owls including Barking Owl and Masked Owl:

Table F-15 Threats to threatened owls

Threatened Owl	Threats
Barking Owl	▪ Clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures ▪ Removal of old, hollow-bearing trees and changes of open forest structure to dense regrowth. ▪ Firewood harvesting resulting in the removal of fallen logs and felling of large dead trees. ▪ Too-frequent fire leading to degradation of understorey vegetation which provides shelter and foraging substrates for prey species. ▪ Disturbance of nesting and excessive disturbance of foraging by inappropriate use of call-playback surveys.
Masked Owl	▪ Loss of mature hollow-bearing trees and changes to forest and woodland structure, which leads to fewer such trees in the future. ▪ Clearing of habitat for grazing, agriculture, forestry or other development. ▪ A combination of grazing and regular burning is a threat, through the effects on the quality of ground cover for mammal prey, particularly in open, grassy forests. ▪ Secondary poisoning from rodenticides. ▪ Being hit by vehicles.

The main factor affecting threatened owls include clearing and degradation of habitat, particularly concerning the loss of mature hollow-bearing trees, which are critical resources for roosting and breeding. Furthermore, large hollows in mature/senescent trees are critically

limiting resources in most habitats, even in large stands of remnant forest that provide core habitat.

Clearing and degradation of habitat has occurred mostly through cultivation, intense grazing and establishment of exotic pastures, while an increased frequency of fire events lead to degradation of understorey vegetation that provides essential habitat and substrate for prey species. Other threats to these species, particularly concerning the Masked Owl include secondary poisoning from rodenticides, which are used to control outbreaks in their preferred food source. Therefore, any pest animal control plan considered for action in the Project Boundary and BOAs will need to consider the required efficacy offset against further potential impacts to these species. Recent sightings and potential home ranges of the Barking Owl and Masked Owl should be considered in any pest animal control plan.

F8.4 Recovery actions

The no specific recovery actions have been identified by the NSW OEH for the Masked Owl and Barking Owl to date, therefore the management and revegetation actions detailed below should be utilised.

F8.5 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality. Habitat types of particular importance for these species include Riverine Woodland and Grassy Woodland on Fertile Soils, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor. Although the Barking Owl and Masked Owl are not necessarily affected by the effects of localised habitat fragmentation, they are susceptible to the effects of habitat loss and degradation, particularly concerning the reduction of critical habitat resources (i.e. large tree hollows). In the medium to long-term, 3,522.5 ha of Habitat restoration and corridor enhancement will likely provide important foraging and potentially breeding in the locality. Moreover, the effective establishment of a regional wildlife corridor is envisaged to provide suitable habitat and movement pathways for all species in the locality, including important prey species. Therefore, a mosaic of habitats in the wildlife corridor, will necessarily provide microhabitat characteristics for such species and potentially provide movement pathways, effective home ranges and importantly, breeding habitat.

Management measures for maintenance of suitable habitat

The Barking Owl and Masked Owl are known to occupy woodland and open forests, including fragmented remnants and partly cleared farmland. Furthermore, due to extensive clearing, woodland habitats on fertile soils are generally scarce in the locality and wider region, effectively leaving smaller fragments and linear riparian strips of remnant trees as the last inhabitable area.

The Barking Owl and Masked Owl have large territories and home ranges, with 2,000 ha being more typical for the Barking Owl in NSW habitats, which is potentially attributable to sparse prey densities. Therefore, the most important management measure in the short-term is the protection of existing habitat (habitat management zones); particularly where these species were recorded along the Namoi River and eastern BOAs for the Masked Owl and Barking Owl respectively. In the long-term, however, a mature restoration of approximately seven kilometres of Riverine Woodland along the Namoi River and other Habitat restoration and corridor enhancement (totalling approximately 3,645.8 ha) will provide important foraging and potential breeding habitat for these species and bolster prey species populations in the locality.

Importantly, large senescent *E. camaldulensis* (River Red Gum) along the Namoi River and White Box in other Grassy Woodland habitats provide suitable roosting and breeding locations. As large trees are not likely to occur in restoration areas for a period greater than 50 years (and more likely greater than 100 years), the maintenance of existing important habitat characteristics (large senescent trees) is critical for the appropriate restoration of the Namoi River floodplain and Grassy Woodland habitats in the BOAs.

Important ecological requirements for these species include the presence of small arboreal mammals such as Squirrel Gliders and Ringtail Possums, most of which are equally dependent on hollow-bearing tree resources. The loss of tree hollows decreases prey populations from which the Barking Owl becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits, while the Masked Owl typically forages on arboreal and terrestrial mammals. Therefore, the restoration of Riverine Woodland and Grassy Woodland habitats (which typically maintain higher prey densities), will in the long-term provide habitat for a variety of potential prey species. However, as tree hollows will not naturally occur in restored habitats for a period greater than 50 years, and more likely over 100 years, restored habitats will need to be supplemented with nest boxes to provide potential roosting/ nesting locations for both threatened owls and their prey species.

In the long-term, management measures particularly concern the effective restoration of the Grassy Woodland on Fertile Soils and Riverine Woodland habitat types across the BOAs. The restoration of derived native grassland through regeneration of the existing soil seed bank (supplemented by further planting of canopy species) will provide important habitat for these species in the locality. Furthermore, the structural elements for the continued survival of these species in the locality will be strengthened with the establishment of regional wildlife corridor networks.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to threatened owls and will be implemented within each BOA:

- active and passive revegetation
- selective thinning
- retention and addition of habitat features
- grazing management
- management of unauthorised access and disturbance.

F8.6 Management actions and performance criteria

Table F-16 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for threatened owls.

Table F-16 Management actions and performance criteria for threatened owls

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and large hollow-bearing trees capable of providing suitable nest locations	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as Other Lands for Agriculture Zone Incorporate appropriate signage on boundary fencing	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs as detailed in Appendix E Upgrade fencing around land designated as Other Lands for Agriculture Zone	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Annual	Annual clearing completion report to be complted by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Biodiversity monitoring	All management zones[1]	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.

Objective	Management zone	Management action	Timing	Performance criteria
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for Little Eagle. Woodlands to contain areas of mid-storey shrubby trees and low shrubs to provide cover for small passerines and provide foraging habitat for Square-tailed Kite.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

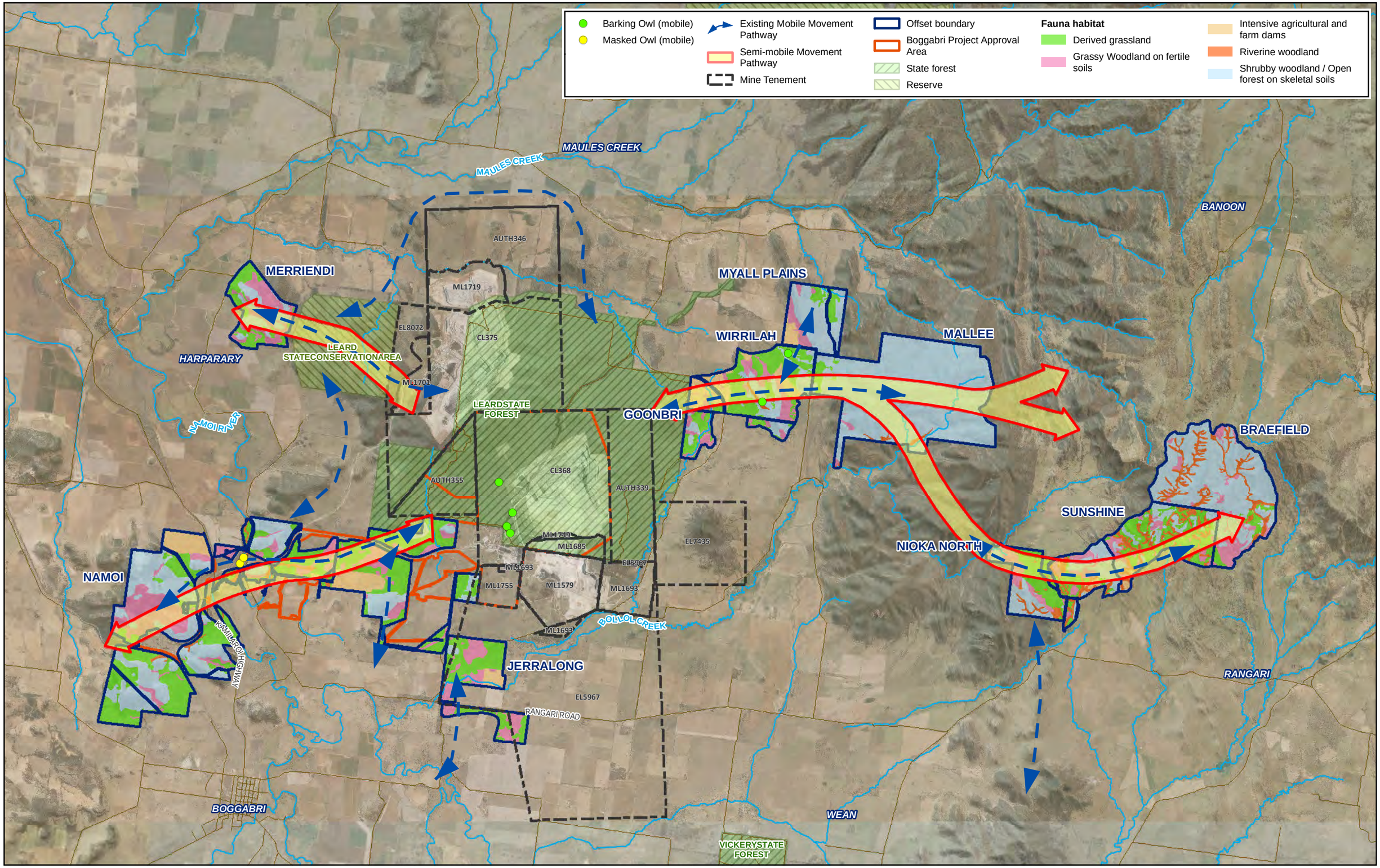
Objective	Management zone	Management action	Timing	Performance criteria
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration Inspections are to be completed on a five yearly basis to determine success of naturally regenerating and planted canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in Habitat Restoration Zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be orchestrated to encourage areas of open woodland and clearings to serve as foraging habitat for Masked Owls.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compard to baseline assessment and milestones nominated in Table F-7.

Objective	Management zone	Management action	Timing	Performance criteria
Provide artificial/ supplementary habitat suitable for breeding. Additionally, availability of nest boxes for arboreal prey species	Habitat restoration and corridor enhancement zones	Incorporate nest boxes in habitat restoration zones areas until natural generation of tree hollows predominates	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F-7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F-7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.

Objective	Management zone	Management action	Timing	Performance criteria
Provision of habitat for terrestrial prey species	Habitat restoration and corridor enhancement	Incorporation of ground timber in habitat restoration zones		Salvaged resources are reused and relocated to BOA Habitat Restoration Zones and are in structurally good condition. Provision of ground timber as per criteria detailed in Table F-7: 10 years • 50 % of ground timber to be incorporated from a restoration age of 10 years, or when regenerating canopy species are commensurate with milestones detailed in Table F-7. 15 years • 100 % of ground timber to be incorporated from a restoration age of 15 years, or when regenerating canopy species are commensurate with milestones detailed in Table F-7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).

Objective	Management zone	Management action	Timing	Performance criteria
Provision of suitable habitat for Barking Owl and Masked Owl	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriulture zone.



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MINE NAME.	2171706A_GIS_BMP015_A2
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-3

TITLE. THREATENED OWLS

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F9 Cave-dependent microchiropteran bats

Cave-dependent species of microchiropteran bat have been assessed together as they generally share similar habitat requirements and threats that affect their recovery.

F9.1 Threatened species profiles

Large-eared Pied Bat (*Chalinolobus dwyeri*)

The Large-eared Pied Bat is listed as Vulnerable under both the EPBC Act and BC Act.

This species has been recorded in scattered localities from near Rockhampton in central coastal Queensland to Bungonia in Southern NSW. It can be found in a variety of dry habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. "Isolated records from subalpine woodland above 1500 m and at the edge of rainforest and moist eucalypt forest, suggest it may tolerate a greater range of habitats than has so far been recorded" (Strahan 1995).

During the daytime, its roosts include caves, mine tunnels and the abandoned, mud-shaped nests of Fairy Martins. While roosting in the caves it often selects positions close to the entrance where individuals huddle together. The Large-eared Pied Bat is thought to be quite manoeuvrable due to a relatively short, broad wing and a low weight per unit area of wing. It is most likely to forage for small flying insects below the forest canopy (Duncan *et al.* 1999).

A group of females and a few males assemble deep inside a roosting site during early spring. Young are born between November and December and are weaned until late January. The colony will disperse from the site during autumn. Females become reproductively mature after one year. During autumn and winter males have enlarged testes and both sexes have swollen glands on the muzzle.

Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)

The Eastern Bent-wing Bat is listed as Vulnerable under the BC Act.

This species is distributed along the east coast of Australia from Cape York in Queensland to Castlemaine in Victoria, predominantly on the eastern side of the Great Dividing Range (Churchill 2008). This species form large maternity colonies in traditional maternity roosts throughout their range during the summer months including, limestone and sandstone caves and abandoned gold mines (Strahan and Van Dyck 2008). Outside the breeding period populations disperse to other roost sites within its own territory (generally within 300 km) including caves, derelict mines, buildings, bridges, culverts and storm water tunnels (NSW Department of Environment and Climate Change 2009a). In southern part of its range, this species selects caves that are cold enough for hibernation during winter, whereas in the northern part of their range they are generally remain active throughout the year (Strahan and Van Dyck 2008).

The Eastern Bent-wing Bat is generally associated with wet and dry sclerophyll forest, rainforest, open woodland and grasslands, where they predominantly forge on moths. Flight is very fast and in forested areas often flies above the canopy. In open areas, flight is often close to the ground. This species is known to forage long distances from roost sites, with several specimens recorded travelling 65 km in one night (Churchill 2008).

Eastern Cave Bat (*Vespadelus troughtoni*)

The Eastern Cave Bat is listed as Vulnerable under the BC Act.

This species is distributed on both sides of the Great Dividing Range from Cape York to Kempsey, with records indicating this species presence from the New England Tablelands to the upper north coast of NSW (NSW Department of Environment and Climate Change 2009b). This species inhabits tropical mixed woodland and wet and dry sclerophyll forest on the coast and Great Dividing Range, extending into drier woodland on the western slopes and inland areas (Churchill 2008). Presumably, the western limit for this species appears to be the Warrumbungle Range (NSW Department of Environment and Climate Change 2009b).

Little is known about the biology of this species, although it is a cave roosting species that is usually found in dry woodland and open forest, particularly near cliffs and rocky overhangs. They roost near the entrance of reasonably well-lit areas often in domes in the roof of caves as well as cracks and crevices. Roost fidelity is thought to be low (Churchill 2008).

Little Pied Bat (*Chalinolobus picatus*)

The Little Pied Bat is listed as Vulnerable under the BC Act.

This species is endemic to Australia and is distributed from near the central Queensland coast through western NSW, extending to far eastern and far northern South Australia and Victoria respectively(NSW Department of Environment and Climate Change 2009d). This species roosts in trees, caves, rock outcrops, abandoned mines and occasionally buildings (Churchill 2008).

The Little Pied Bat occurs in dry open woodland/ open forest, mulga woodlands, cypress pine forest and mallee, where they feed predominantly on moths (NSW Department of Environment and Climate Change 2009d). This species occurs in areas where water is highly ephemeral and has been recorded making nightly return trips of 14 to 34 km between a roost site and a creek bed with small stands of water (Strahan and Van Dyck 2008). This species flight is fast and highly manoeuvrable, flying close to the canopy and sometimes among vegetation, gleaning from the canopy (Churchill 2008).

F9.2 Distribution of cave-dependent microchiropteran bats

Large-eared Pied Bat

The Large-eared Pied Bat was potentially recorded via an Anabat recording in the Project Boundary. While the recording was relatively poor in quality, suitable roosting requirements for this species have been observed in the BOAs (refer Table F-6 and Figure F-4).

Eastern Cave Bat

The Eastern Cave Bat was trapped in the Project Boundary during targeted surveys, while a cave located in the Namoi BOA was observed to contain approximately 85 Eastern Cave Bat's (refer Table F-6 and Figure F-4). Two bat exit surveys were completed, with a harp trap set-up at the cave entrance on one occasion. Sixteen individuals were trapped as they exited the cave with subsequent measurements revealing an approximate ratio of 1:8 (males: females). As both male and female bats were recorded, it is assumed that the site could be used as a maternity cave.

Eastern Bent-wing Bat and Little Pied Bat

The Eastern Bent-wing Bat and Little Pied Bat have previously been recorded in the Project Boundary and the Namoi BOA respectively (refer Table F-6 and Figure F-4).

F9.3 Threats

The main threats affecting cave-dependent microchiropteran bats (combined for all species) include:

- loss or modification of habitat (including feeding habitat) near roosting and maternity sites
- clearing and isolation of dry eucalypt forest and woodland, particularly about cliffs and other areas containing suitable roosting and maternity sites, mainly as a result of agriculture or development
- loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities, vegetation and too-frequent burning
- disturbance to roosting areas by goats
- predation by cats and foxes
- introduction of exotic pathogens such as white-nose fungus
- application of pesticides in or adjacent to foraging areas may reduce the availability of invertebrates, or result in the accumulation of toxic residues in individuals' fat stores
- damage to or disturbance of roosting and maternity caves, particularly during winter or when breeding
- Mining operations and recreational activities (such as caving) being examples.

F9.4 Recovery actions

The following applicable recovery actions have bene identified by the NSW OEH for the cave-dependent microchiropteran bats (combined for all species):

- Protect caves and overhangs
- Control feral goats in rock overhangs and caves
- Retain hollow-bearing trees
- Reduce fragmentation and promote creation of corridors between remnant vegetation
- Protect and maintain high quality foraging habitat, particularly high productivity habitats, primarily riparian areas, wetlands and other areas of native vegetation with high moisture status and fertility.
- Undertake revegetation, using a diverse mix of locally appropriate native species. Revegetation should focus on areas of good moisture and fertility, particularly riparian

areas and wetlands. Priority should be given to expanding existing small habitat patches.

- Identify and protect roost habitat artificial structures such as culverts, old buildings and mines
- Undertake long-term monitoring of populations
- Remove vegetation encroaching on cave entrances with minimum disturbance
- Protect recruit trees that will be able to provide hollows in the future. Develop and implement a bush regeneration strategy (which includes monitoring and reporting requirements) targeting the removal of weeds significantly compromising habitat values and restore native vegetation. Care should be taken to avoid widespread removal of beneficial exotic woody vegetation without replacement. Manual weed removal is preferable and the use of herbicides should avoid non-target impacts.
- Identify and restrict access to maternity and roost sites, particularly during winter torpor and breeding season.

F9.5 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Habitat of particular importance to these species includes the Namoi and Mallee BOAs. The Namoi BOA contained at least one maternity cave for the Eastern Cave Bat. Moreover, surrounding rocky plateaus and small escarpments potentially contain further roosting or breeding habitat. The Mallee BOA is situated along the Nandewar Range and contains large areas of rocky outcrops, escarpments and cliff lines, all of which are likely to contain potential roosting and maternity locations for these species. Together these properties represent potentially important habitat for the maintenance of these species in the locality.

Habitat restoration and corridor enhancement zones

In the medium to long-term it is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing habitat management zones in providing important foraging habitat in the locality. Although threatened cave-dependent microchiropteran bats are not necessarily affected by the effects of localised habitat fragmentation (i.e. relatively high mobility), they are susceptible to the effects of habitat loss and degradation, particularly concerning the removal of foraging habitat near roosting and maternity sites. Therefore, the establishment of a regional wildlife corridor is envisaged to provide suitable movement pathways from roost sites to foraging locations in an otherwise largely cleared landscape.

Management measures for maintenance of suitable habitat

The main threats affecting threatened cave-dependent microchiropteran bats include the loss and modification of habitat (including foraging habitat) near roosting and maternity sites, clearing and isolation of dry eucalypt woodland/ forest, particularly around cliff lines and areas containing suitable roosting and breeding habitat, and damage or disturbance to roosting and maternity caves, particularly during winter or when breeding.

Therefore, the most important management measure in the short-term is the protection of the known roost/ maternity cave located in the BOA. Protection will also be afforded to the remainder of the Namoi offset, particularly concerning suitable habitat in surrounding rocky plateaus in proximity to the known roost location. Furthermore, protection will be afforded to the extensive Mallee BOA, particularly concerning rocky outcrops, escarpments and cliff lines that likely provide suitable roosting and maternity sites for threatened cave-dependent microchiropteran bats.

Furthermore, due to extensive clearing of woodland and forest habitats in the locality and wider region, smaller fragments and linear riparian strips of remnant trees effectively occur as the last inhabitable areas for foraging. Therefore, in the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting known roosting sites on the Namoi BOA with the Mallee BOA that occurs as part of Nandewar Range in the east. In the long-term, it is envisaged that the restoration of regional wildlife corridor will likely form important foraging habitat for these species in the locality.

Another important management measure will be the appropriate use of any pesticide or herbicide within the Project Boundary and BOAs. Such chemicals may reduce the availability of invertebrates in nearby foraging areas or result in the accumulation of toxic residues in individuals.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to threatened cave-dependent microchiropteran bats and will be implemented within each BOA:

- active and passive revegetation
- weed and pest control, including the control of feral cats
- management of unauthorised access and disturbance.

F9.6 Management actions and performance criteria

Table F-17 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for cave-dependant microchiropteran bats.

Table F-17 Management actions and performance criteria for cave-dependent microchiropteran bats

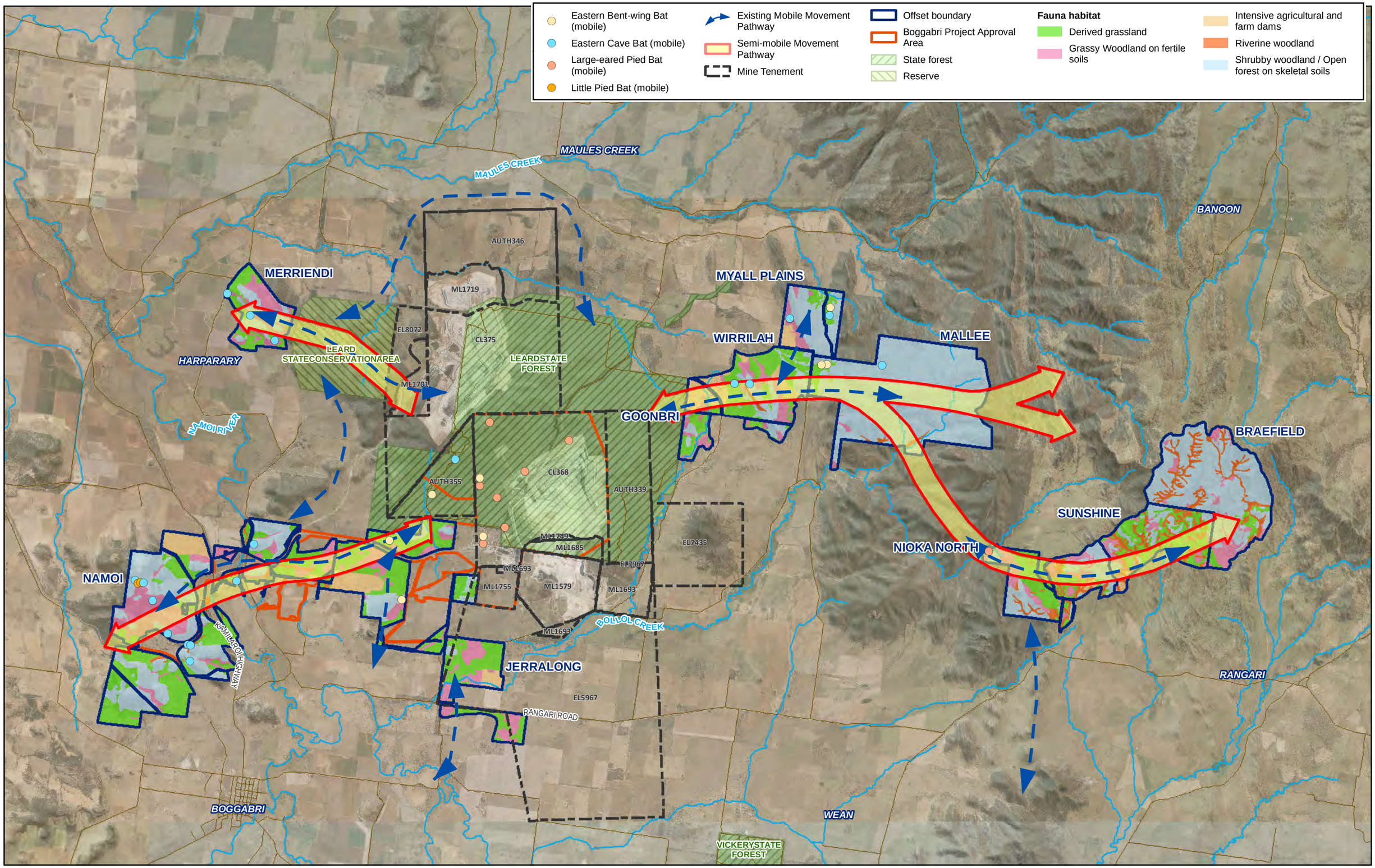
Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of known and potential roosting/ maternity sites	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as other lands for agriculture zone Incorporate appropriate signage on boundary fencing	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E Upgrade fencing around land designated as other lands for agriculture zone	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

Objective	Management zone	Management action	Timing	Performance criteria
Biodiversity monitoring	All management zones	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.
Minimise application of pesticides/herbicides	All management zones[1]	Limit use of pesticides/insecticides to that absolutely necessary for effective use of agricultural lands	Annual	Document all use of pesticides/insecticides on agricultural lands that occur immediately adjacent to the wildlife corridor (i.e. those areas were excess use may affect insect abundance or availability for foraging microchiropteran bats.
Habitat use	Habitat management	Annual biodiversity monitoring targeting threatened cave-dependent microchiropteran bats (refer Section 7.2 of the main BMP document).	Annual	Monitoring of microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Continued records for Eastern Cave Bat within the BOAs; particularly Namoi BOA which includes the Eastern Cave Bat maternity cave. Provision of annual biodiversity offset monitoring report detailing threatened species recorded.
Medium-term				

Objective	Management zone	Management action	Timing	Performance criteria
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as ecotonal foraging habitat for microchiropteran bats.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration (including corridor enhancement zones). Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as ecotonal foraging habitat for microchiropteran bats.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F-7.

Objective	Management zone	Management action	Timing	Performance criteria
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for cave-dependent microchiropteran bats	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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MINE NAME.	2171706A_GIS_BMP015_A2
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-4

TITLE. THREATENED CAVE-DEPENDENT MICROCHIROPTERAN BATS

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F10 Hollow-dependent microchiropteran bats

Hollow-dependent microchiropteran bat have been assessed together as they generally share similar habitat requirements and threats that affect their recovery.

F10.1 Threatened species profiles

Corben's Long-eared Bat (***Nyctophilus corbeni***)

Corben's Long-eared Bat is listed as Vulnerable under the EPBC Act and BC Act.

Corben's Long-eared Bats inhabit a variety of vegetation types, including mallee and box eucalypt dominated communities, but they are distinctly more common in box/ironbark/cypress-pine vegetation, which occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. They roost in tree hollows, crevices and under loose bark. It is a slow flying, agile bat using the understorey to hunt non-flying prey — especially caterpillars and beetles — and will even hunt on the ground. Mating takes place in autumn, with one or two young born in late spring to early summer (Churchill 2008).

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle is listed as Vulnerable under the BC Act.

This species is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (Department of Environment and Climate Change 2005; Department of Environment and Conservation 2005a). Its distribution extends over the Great Dividing Range, with a preference for wet altitude forests. This species is thought to hunt beetles and moths above, or just below the canopy. The Eastern False Pipistrelle roosts in tree hollows, although it can sometimes be found in caves (Jenolan area) and buildings (Churchill 1998). This species hibernates during winter, with females pregnant in late spring-early summer (NSW Department of Environment and Climate Change 2009c).

Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

The Yellow-bellied Sheathtail-bat is listed as Vulnerable under the BC Act.

This species is wide ranging and found across northern and eastern Australia, encompassing the majority of NSW. Although, only scattered records exist across the New England Tablelands and north-west slopes (NSW Department of Environment and Climate Change 2009e). This species occurs in eucalypt forest where it flies high above the canopy, feeding on insects.

In mallee or open country it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows and is thought to be a migratory species to southern Australia during late summer and autumn (Churchill 1998). Breeding has been recorded from December to late March in this species (NSW Department of Environment and Climate Change 2009e).

F10.2 Distribution of hollow-dependent microchiropteran bats

Corben's Long-eared Bat

This species has previously been recorded in Leard State Forest (Pennay, Michael 2001) with suitable habitat existing therein (refer Table F-6 and Figure F-5). It has also been recorded during targeted surveys in the Namoi BOA on the Victoria Park property (refer Table F-6 and Figure F-5). Suitable habitat for *Nyctophilus* species has been identified within the BOAs via anabat recording (refer Appendix L). Future survey for the Corben's Long-eared Bat will be focused on these areas which are illustrated in Appendix L and reproduced below. Multiple individuals have now been captured in the Namoi BOA and Myall Plains BOA by harp trapping methodology during targeted surveys.

Eastern False Pipistrelle

This species has previously been recorded in the Project Boundary and five of the seven BOA's via Anabat recordings (refer Table F-6).

Yellow-bellied Sheathtail-bat

This species has been recorded on numerous occasions in the Project Boundary via Anabat recording; while several individuals have been observed and relocated during tree clearing operations that occur as part of mining operations (refer Table F-6 and Figure F-5). This species has also been recorded within five of the seven BOAs (refer Table F-6) and as it is most readily associated with areas of Grassy Woodland on Fertile Soils habitat it is likely that it will be recorded within recently acquired BOAs when suitable seasonal surveys are conducted.

F10.3 Threats

The main threats affecting hollow-dependent microchiropteran bats (combined for all species) include:

- loss and fragmentation of foraging habitat, particularly extensive areas of continuous forest and areas of high productivity and mallee habitat
- loss of hollow-bearing trees
- disturbance and loss of roosting and breeding sites.
- application of pesticides/ herbicides in or adjacent to foraging areas, reducing the availability or abundance of insects, or result in the accumulation of toxic residues in individuals.

F10.4 Recovery actions

The following applicable recovery actions have bene identified for all species by the NSW OEH:

- Protect and maintain areas of high quality habitat, particularly areas of extensive tall forest (dominated by trees more than 20m in height), which include areas of high productivity foraging habitat around creeks, rivers and wetlands.

- Retain and protect hollow-bearing trees in suitable habitat. Ensure long-term hollow availability by protecting recruit trees, that is, trees that will be able to provide hollows when current hollow-bearing trees have died and fallen.

- Undertake revegetation, using a locally appropriate mix of native species, in areas that will develop into tall forest. Revegetation should focus on expanding existing smaller areas of suitable habitat, and areas of high productivity such as riparian areas and wetlands. Maintain and improve travelling stock reserves used by the species. A diversity of local native species should be planted.

- Ensure roosting bats are not present before removing or disturbing hollow-bearing trees in winter.

- Control or remove exotic weeds, particularly in riparian zones, that degrade habitat and alter the structure of the vegetation community in areas of the species' distribution. Ensure that such weed control work be undertaken in a staged manner and minimises disturbance to the habitat of the species and prey species (insects). Develop and implement a bush regeneration strategy (which includes monitoring and reporting requirements) targeting the removal of weeds significantly compromising habitat values such as the repression of future hollow-bearing trees. Care should be taken to avoid widespread removal of vegetation without replacement. Manual weed removal is preferable and the use of herbicides should avoid non-target impacts. Leave dead trees standing.

- Ensure that areas immediately surrounding maternity and roost sites are identified as an important biodiversity asset in any relevant fire planning and have a 100m buffer zone applied. Planned fires near maternity or roosting sites should not be undertaken during the breeding season, i.e. October to January, or during winter when bats are in residence. Hazard reduction burns in box/ironbark/cypress pine vegetation communities where the bats are known or suspected of using should not occur more than once every 20-50 years. Liaise with the Rural Fire Service, National Parks and Wildlife Service, or relevant land manager, to ensure that prescribed burns that may affect habitat are cool burns and/or do not kill hollow-bearing trees.

F10.5 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Habitat of particular importance for these species include Grassy Woodland on Fertile Soils and Riverine Woodland, which approximate 1,676.1 ha and 596.3 ha respectively in habitat management zones, as they contain large trees that generally provide an abundance of tree hollows of varying size classes. Furthermore, large areas of existing habitat (habitat management zones), such as that located in the Myall Plains, Wirrilah, Mallee, and the western portion of the Namoi BOAs, are likely to provide important habitat attributes for these species.

Habitat restoration and corridor enhancement zones

In the medium to long-term it is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing habitat management zones and effectively contribute to the viability of a

local and regional wildlife corridor. Although, these species are not necessarily affected by the localised small-scale fragmentation of habitat, they are all susceptible to the effects of habitat loss, particularly concerning the loss of critical resources (i.e. hollow-bearing trees). Furthermore, hollow-dependent microchiropteran bats are more readily associated with large remnants of suitable habitat, often due to the provision of necessary roosting, breeding and foraging habitat.

Therefore, the effective restoration of areas of derived native grassland and agricultural land (Habitat restoration and corridor enhancement zones) will likely provide suitable habitat (including potential breeding habitat) and movement pathways for these species in the locality. A mosaic of habitats in the wildlife corridor will necessarily provide important microhabitat characteristics important for invertebrates, which comprise important prey species.

Management measures for maintenance of suitable habitat

The main threats affecting hollow-dependent microchiropteran bats, include the loss and fragmentation of habitat; loss of critically limiting resources (tree hollows); disturbance of roosting and breeding habitat; and application of pesticides and herbicides that may reduce the availability and/ or abundance of invertebrate prey.

Therefore, the most important management measure in the short-term is the protection of existing habitat (habitat management zones) in BOAs. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing those displaced individuals to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

Due to extensive habitat destruction in the locality and wider catchment area, smaller fragments and riparian strips of remnant trees effectively occur as the last inhabitable areas for these species. Therefore, in the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the restoration of the regional wildlife corridor will likely form important roosting, breeding and foraging habitat for these species in the locality. As these species are reliant on critically limiting resources (i.e. tree hollows), which will not naturally occur in areas of restoration (Habitat restoration and corridor enhancement zones) for a period greater than 50 years, and more likely greater than 100 years, restoration areas will need to be supplemented with appropriately sized nest boxes that may offer potential roosting and breeding habitat in the short to medium-term.

Another important management measure will be the appropriate use of any pesticide or herbicide. Such chemicals may reduce the availability of invertebrates in nearby foraging areas or result in the accumulation of toxic residues in individuals.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to threatened hollow-dependent microchiropteran bats and will be implemented within each BOA:

- active and passive revegetation
- retention and addition of habitat features, including natural hollows and nest boxes

F10.6 Management actions and performance criteria

Table F-18 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for hollow-dependent microchiropteran bats.

Table F-18 Management actions and performance criteria for hollow-dependent microchiropteran bats

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and trees capable of providing suitbale roost/ breeding locations	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as other lands for agriculture zone Incorporate appropriate signage on boundary fencing	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E Upgrade fencing around land designated as other lands for agriculture zone	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside

Objective	Management zone	Management action	Timing	Performance criteria
		clearing limits, necessary procedures and activities.		approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Biodiversity monitoring	All management zones[1]	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.
Habitat use	Habitat management	Annual biodiversity monitoring targeting threatened hollow-dependent microchiropteran bats (refer Section 7.2 of the main BMP document).	Annual	Monitoring of microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Continued records for threatened hollow-dependent microchiropteran bats within the BOAs; particularly for Yellow-bellied Sheathtail-bat. Provision of annual biodiversity offset monitoring report detailing threatened species records.

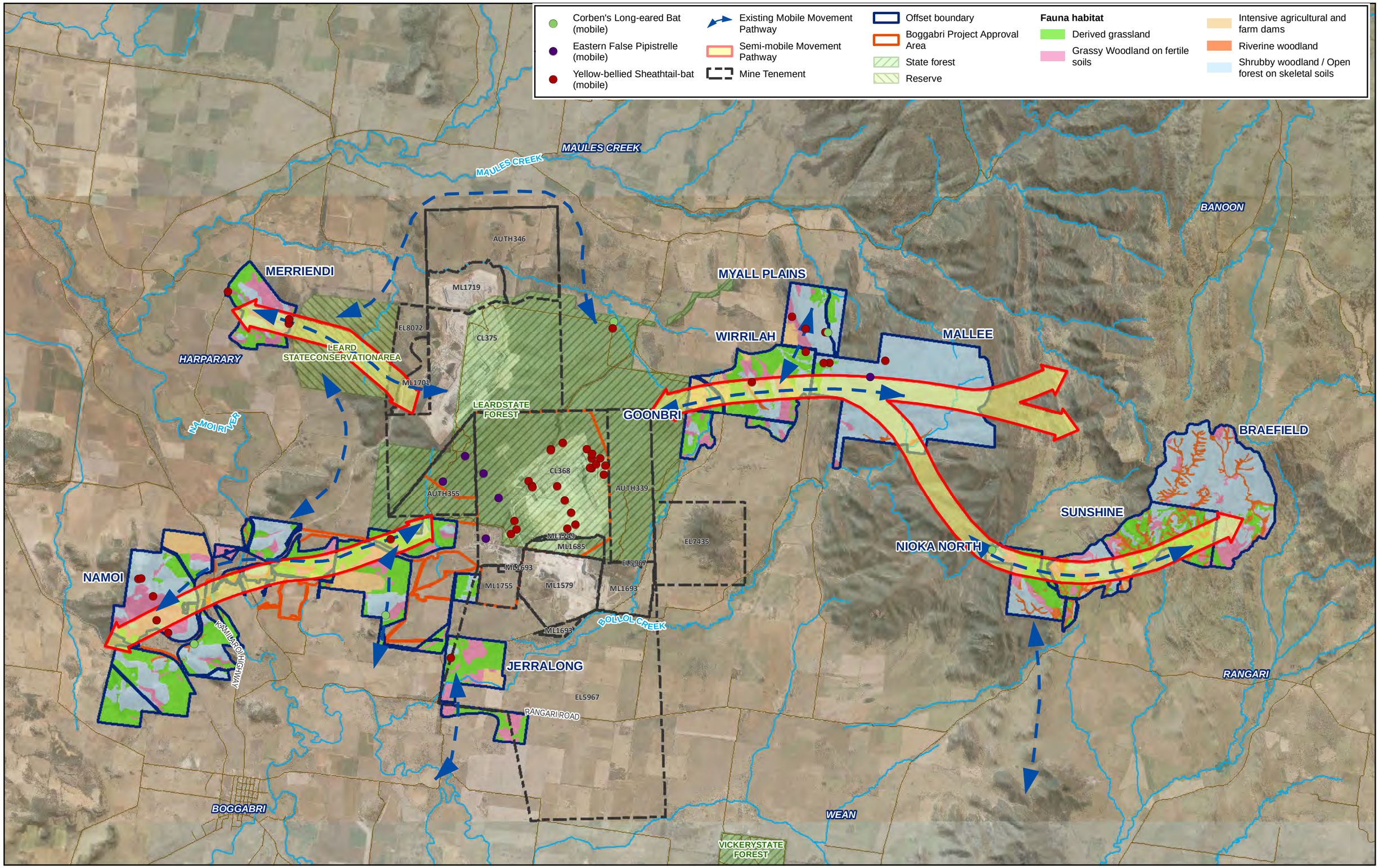
Objective	Management zone	Management action	Timing	Performance criteria
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for Yellow-bellied Sheathtail-bat. Woodlands to contain areas of mid-storey shrubby trees and low shrubs to provide cover for Corben's Long-eared Bat.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for Yellow-bellied Sheathtail-bat. Woodlands to contain areas of mid-storey shrubby trees	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F-7.

Objective	Management zone	Management action	Timing	Performance criteria
		and low shrubs to provide cover for Corben's Long-eared Bat.		
Provision of artificial/ supplementary habitat suitable for roosting and breeding	Habitat restoration and corridor enhancement zones	Incorporate nest boxes in habitat restoration zones areas until natural generation of tree hollows predominates	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers).

Objective	Management zone	Management action	Timing	Performance criteria
				Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for hollow-dependent microchiropteran bats	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting microchiropteran bats (refer Section 7.2 of the main BMP document).	15 years 20 years 30+ years	Annual monitoring of microchiropteran bat species richness and abundance completed as part of the BOA monitoring program. Habitat restoration zones and corridor enhancement zones show an observed increase in microchiropteran bat species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document). Records of hollow-dependent microchiropteran bats, particularly Yellow-bellied Sheathtail-bat, utilising areas of restoration where canopy species are commensurate with milestones detailed in Table F- 8. Provision of annual biodiversity offset monitoring report detailing threatened species records.

Objective	Management zone	Management action	Timing	Performance criteria
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks. Documentation detailing any use crash grazing (i.e. BOA, management zone, time period).

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
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APPENDIX F-5

TITLE. THREATENED HOLLOW-DEPENDENT MICROCHIROPTERAN BATS

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F11 Turquoise Parrot (*Neophema pulchella*)

The Turquoise Parrot is listed as Vulnerable under the BC Act.

Turquoise Parrots occur in the foothills of the Great Dividing Range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey, often in the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (Department of Environment and Conservation 2006b). They nest in tree hollows, stumps or even fence posts, from August to December, laying four or five eggs on a nest of decayed wood dust. This species is usually seen in pairs or small, possibly family groups and has also been reported in flocks of up to 30 individuals (Higgins 1999). The parrots spend most of the day on the ground and feed on seeds of both native and introduced grass and herb species. They forage quietly and may be quite tolerant of disturbance (Garnett & Crowley 2000).

F11.1 Distribution of Turquoise Parrot

The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range (OEH, 2015).

The Turquoise Parrot has been recorded on numerous occasions in the Project Boundary, while several observations are attributable to BOAs; particularly in BOA's to the east of Leard State Forest (refer Table F-6 and Figure F-6).

F11.2 Threats

The main threats that affect the Turquoise Parrot identified by NSW OEH include:

- clearing of grassy woodland and open forest habitat
- loss of hollow-bearing trees, firewood collection
- degradation of habitat through intensive agricultural practices, particularly heavy grazing and establishment of exotic pastures
- predation by foxes and cats
- illegal trapping of birds and collection of eggs
- inappropriate fire regimes
- aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners
- climate change impacts including reduction in resources due to drought.

F11.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Turquoise Parrot:

- Develop and implement a nest box that has clear objectives and includes monitoring, maintenance and evaluation of success.

- Undertake restoration and revegetation to replace cohorts of trees where they have been removed from the landscape, particularly in areas adjacent to and connecting woodland remnants

- Conserve ground layer and mid-story vegetation by implementing sensitive grazing practices and avoiding lashing to promote the retention of a floristically and structurally diverse understory.

- Target removal of weeds significantly compromising habitat values and restore native vegetation.

- Measure the abundance and impact of noisy miners on species populations and habitat, and implement appropriate management actions to reduce the impact of Noisy Miners where required.

- Undertake revegetation, using a diverse mix of locally appropriate native species, focussing on expanding areas of existing habitat, connecting isolated habitat patches (either through corridor or stepping stone plantings) or establishing additional habitat patches in landscapes with already existing, although insufficient, patches of suitable habitat. Areas with access to water, especially riparian areas, are particularly important, although care should be taken to ensure that riparian revegetation programs are sufficiently wide (minimum 50m wide).

F11.4 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). These areas of existing high quality habitat provide areas actively used by this species. Habitat of particular importance includes areas dominated by White Box due to the generally high abundance of tree hollows.

Habitat restoration and corridor enhancement zones

In the medium to long-term it is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing habitat management zones and effectively contribute to the viability of a local and regional wildlife corridor. Although the Turquoise Parrot is not necessarily affected by localised small-scale fragmentation of habitat, the species is susceptible to the effects of habitat loss, particularly concerning the loss of critical resources (i.e. hollow-bearing trees) and degradation of habitat through agricultural practices.

The restoration of areas of derived native grassland and agricultural land (Habitat restoration and corridor enhancement zones) will likely provide suitable habitat (including potential breeding habitat) and movement pathways for this species in the locality. Furthermore, as the Turquoise Parrot typically forages on the seeds of native grasses and herbaceous plants, and is often associated with ecotone or edge habitat (i.e. edges of eucalypt woodland and adjoining clearings), a mosaic of habitats in the wildlife corridor will necessarily provide important microhabitat characteristics for this species.

In the short-term, early shrub and tree growth, supplemented with fallen timber will likely provide sufficient habitat complexity to afford safe foraging opportunities. Initial careful plant spacing provides for open foraging areas with increase shelter offered by maturing canopy species. It is estimated that following 15 years of restoration, stabilised habitat usage will occur as open foraging areas continue to exist in a mosaic structure, potentially with established breeding territories, where nest boxes are provided as a supplementary habitat feature.

Management measures for maintenance of suitable habitat

The main threats affecting the Turquoise Parrot involve the loss of habitat, including critical resources such as hollow-bearing trees and the degradation of habitat through intensive agricultural practices, including heavy grazing and the establishment of exotic pastures.

Therefore, the most important management measure in the short-term is the protection of existing habitat management zones in BOAs, including the restricted access of site personnel and the general public, particularly concerning the removal of standing dead trees for fire wood. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the clearing and fauna management procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing those displaced individuals (from established breeding territories) to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

Due to extensive habitat destruction in the locality and wider catchment area, smaller fragments and riparian strips of remnant trees effectively occur as the last inhabitable areas for the Turquoise Parrot. Therefore, in the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the successful restoration of a regional wildlife corridor will likely form important foraging and breeding habitat in the locality. As the Turquoise Parrot is reliant on critically limiting resources (i.e. tree hollows), which will not naturally occur in areas of restoration (Habitat restoration and corridor enhancement zones) for a period greater than 50 years, and more likely greater than 100 years, restoration areas will require provision of appropriately sized nest boxes that may offer potential breeding habitat in the short to medium-term.

Another important management measure will be the appropriate planting of Habitat restoration and corridor enhancement zones, as to provide a mosaic of habitats in the regional wildlife corridor. This would potentially provide suitable foraging areas, while still maintaining areas of cover to escape predators. The Turquoise Parrot is known to be predated by foxes and cats. Therefore, the appropriate control of such species will be integral to the successful establishment of a wildlife corridor that provides potential breeding territories and home ranges.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Turquoise Parrot and will be implemented within each BOA:

- active and passive revegetation
- retention and addition of habitat features, including natural hollows and nest boxes
- selective thinning

- weed and pest control, including the control of foxes and feral cats
- grazing management
- management of unauthorised access and disturbance.

F11.5 Management actions and performance criteria

Table F-19 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Turquoise Parrot.

Table F-19 Management actions and performance criteria for Turquoise Parrot

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat	All management zones[1]	Upgrade boundary fencing of all BOAs Upgrade fencing around land designated as other lands for agriculture zone Incorporate appropriate signage on boundary fencing	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E Upgrade fencing around land designated as other lands for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B)	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Biodiversity monitoring	All management zones[1]	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.

Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat management zone	Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	Annual	Monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat Management Zones show no observed significant decrease (i.e. greater than 40 % reduction sustained over three consecutive sampling periods) in bird species richness across the BOAs that cannot be attributed to natural variation against baseline monitoring site data. Continued records of Turquoise Parrot within BOAs. Provision of annual biodiversity offset monitoring report detailing threatened species records.
Medium-term				

Objective	Management zone	Management action	Timing	Performance criteria
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites. Planting and regrowth to be managed to encourage areas of open woodland and clearings interspersed with areas of mid-storey shrubby trees and low shrubs to provide cover foraging habitat for Turquoise Parrot.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.
Canopy growth	Habitat restoration and corridor enhancement	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species. Planting and regrowth to be managed to encourage areas of open woodland and clearings interspersed with areas of mid-storey shrubby trees and low shrubs to provide cover foraging habitat for Turquoise Parrot.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F-7.

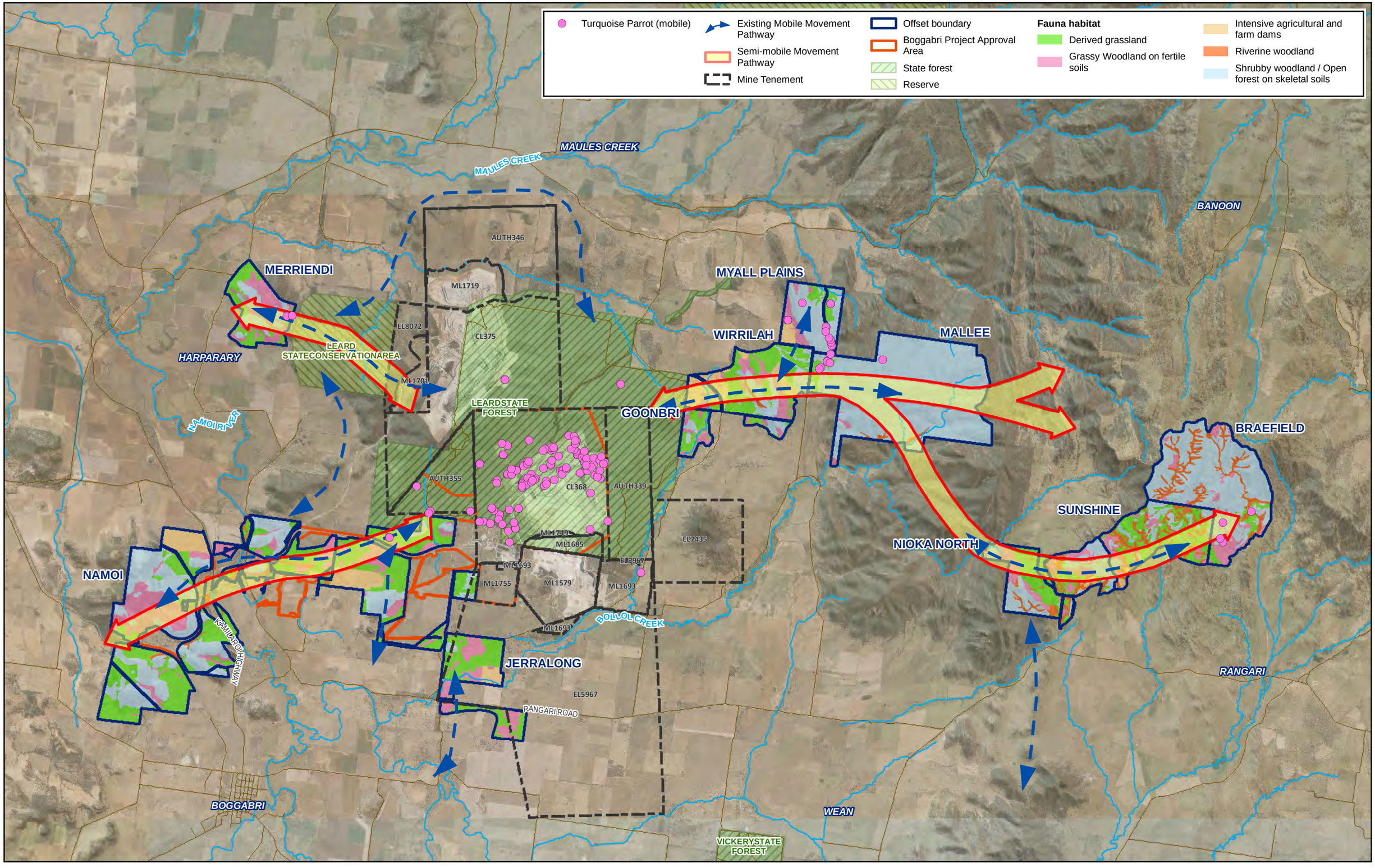
Objective	Management zone	Management action	Timing	Performance criteria
Provision of artificial/ supplementary habitat suitable for breeding	Habitat restoration and corridor enhancement zones	Incorporate nest boxes in habitat restoration zones until natural generation of tree hollows predominate	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F 7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.
Long-term				

Objective	Management zone	Management action	Timing	Performance criteria
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Turquoise Parrot	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	15 years 20 years 30+ years	Annual monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat restoration zones and corridor enhancement zones show an observed increase in diurnal bird species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document). Records of Turquoise Parrot, utilising areas of restoration where canopy species are commensurate with milestones detailed in Table F- 8. Provision of annual biodiversity offset monitoring report detailing threatened species records.

Objective	Management zone	Management action	Timing	Performance criteria
Control of pest species, particularly foxes and cats	All management zones[1]	Complete strategic culling events or baiting programs as necessary	>2 years	Annual BOA Biodiversity Monitoring Report shows an overall reduction in pest animal species (particularly foxes and cats) and population sizes targeted by control measures implemented across all management zones across all BOAs (taking into consideration potential drought conditions and seasonal trends). Pest animal control is undertaken in accordance with relevant Codes of Practise and Standard Operating Procedures as detailed in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new pest occurrences are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



0 1 2 3 kilometres

Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-6

TURQUOISE PARROT

TITLE.

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F12 Threatened woodland birds

Threatened woodland birds gave been assessed together as they generally share similar habitat requirements and threats that affect their recovery. All nine species are part of a group of woodland birds considered to be declining within Australia (Reid 1999; Trail & Duncan 2000) and all are listed as Vulnerable under the BC Act.

F12.1 Threatened species profiles

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

Brown Treecreepers occur in eucalypt woodland and adjoining vegetation. Sometimes this species is recorded in semi-cleared pasture; in grasslands scattered with trees in cleared paddocks outside woodlands or in shelterbelts fringing cleared lands (Higgins & Peter 2002). It is sedentary and nests in tree hollows (Garnett & Crowley 2000) breeding in pairs or communally in small groups within territories ranging in size up to 11 ha. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site (Higgins *et al.* 2001). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (Pizzey & Knight 2007).

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

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

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

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

Painted Honeyeater (*Grantiella picta*)

Painted Honeyeaters occur in dry forests and woodlands. The primary food is mistletoes in the genus Amyema, although they will take some nectar and insects (Department of Environment and Conservation 2006b). The breeding distribution is dictated by the presence of mistletoes, which are largely restricted to older eucalypts. In many areas they particularly favour mistletoes such as *Amyema quandang* (Grey Mistletoe), which favour *Acacia* sp., and mistletoes such as *A. cambagei* and *A. linophylla*, which favour she-oak species. The species is less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

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

An understorey of young trees and shrubs, in the 10 to 25 cm diameter at breast height range, is used for nest sites and shelter, and a relatively sparse ground layer with more litter and less ground cover is preferred by the species (Adam & Robinson 1996). Within that broad habitat category, they prefer sites with large trees, a scattered understorey of small trees or shrubs and a sparse ground layer of litter and short grass (Davidson & Robinson 1992). At the local scale, the species is common in edge habitats where there is access to both tree-cover and open ground. Historically this edge habitat would be found near larger trees in mature woodland habitat, but is now largely restricted to roadside vegetation and the edges of remnant patches (Robinson *et al.* 2001). The Grey-crowned Babbler is a prolific nest builder, building nests throughout the year for both breeding and roosting (Counsilman 1979), and defend a territory of approximately 10 ha, however territories up to 50 ha have been recorded.

Speckled Warbler (*Pyrrholaemus sagittatus*)

Speckled Warblers prefers woodland vegetation, often on rocky ridges or in gullies (NSW Scientific Committee 2001). Although they occur in habitats with grassy ground cover, they require shrubby understorey vegetation for shelter, foraging and breeding purposes. The bird is a sedentary species that breeds in pairs and trios, and largely feeds on insects, sometimes taking seeds on the ground and in understorey vegetation. It builds dome-shaped nests on the ground in grass tussocks, dense leaf litter and fallen branches (Reid 1999). Speckled Warblers occur at low densities (0.19-0.54 per ha) and have relatively large home ranges of 6-12 ha for pairs or trios of birds (Higgins & Peter 2002).

Diamond Firetail (*Stagonopleura guttata*)

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

Varied Sittella (*Daphoenositta chrysoptera*)

The Varied Sittella is sedentary and inhabits most of mainland Australia, with a nearly continuous distribution in NSW from the coast to the far west (Higgins & Peter 2002). It inhabits open eucalypt forests and woodlands (particularly rough-barked species), mallee, inland acacia woodland and coastal tea-tree scrubs (Pizzey & Knight 2007).

Varied Sittella are highly social, with groups foraging together, whereby they fly into the heads of trees and generally make their way down limbs and the trunk of the tree. They feed on arthropods, which are gleaned from dead branches, small branches in the canopy and crevices from rough or decorticating bark (NSW Scientific Committee 2009d). This species typically breeds in groups of five to seven individuals during spring and summer, with nests well camouflaged and situated in a fork, high in the living tree canopy. The same fork or tree is often used in successive years. During winter this species forms larger companies.

The threats that affect Varied Sittella include the continued decline in habitat cover and quality (Watson *et al.* 2005). Furthermore, cleared agricultural landscapes potentially act as a barrier to movement and dispersal due the sedentary nature of this species. Thus, survival and population viability is considered sensitive to processes such as reduction in patch size and isolation and simplification of habitat including the removal of canopy cover, logs, fallen branches and litter. Therefore, three Key Threatening Processes listed under the BC Act affect this species; clearing of native vegetation, loss of hollow-bearing trees and the removal of dead wood and dead trees.

Pied Honeyeater (*Certhionyx variegatus*)

The Pied Honeyeater is widespread throughout acacia, mallee and spinifex scrubs of arid and semi-arid Australia and occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought.

This species constructs a relatively large cup-shaped nest, usually robust, although occasionally loose, constructed of grasses and fine twigs and bound with spider webs, in the fork of a shrub or tree up to 5 m above the ground.

F12.2 Distribution of threatened woodland birds

With the exception of Pied Honeyeater, all of the assessed threatened woodland birds have been recorded within the Project Boundary. Each species has been recorded or is predicted to occur in each BOA (refer Table F-6 and Figure F-7).

F12.3 Threats

The primary threats identified by NSW OEH that affect threatened woodland birds (all species) include:

- clearing of grassy woodland and open forest habitat, including thinning of trees bearing mistletoe
- fragmentation of grassy woodland, pen forest and mallee habitat
- removal of coarse, woody debris within woodland remnants
- predation of eggs and nestlings by increased populations of native predators such as the Pied Currawong (*Strepera graculina*)
- degradation of habitat through intensive agricultural practices, particularly heavy grazing and establishment of exotic pastures
- lack of regeneration of eucalypt overstorey in woodland due to overgrazing and too-frequent fires
- nest predation by species such as ravens and butcherbirds may be an issue in some regions where populations are small and fragmented.

- disturbance and changes to vegetation structure due to forestry activities (e.g. fire and harvesting)
- loss of ground litter from compaction and overgrazing
- inappropriate forestry management practices
- removal of large, old trees with heavy mistletoe infestations
- aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners
- competition from invasive weeds
- loss of understorey habitat
- habitat infestation by weeds such as African boxthorn, Gazania and invasive grasses
- reduction in resources due to drought and climate change
- the clearing of nectar-producing shrubs (such as *Eremophila* and *Grevillea* spp.) reduces food supplies and may interrupt broad scale nomadic movements
- predation by foxes and cats.

F12.4 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for threatened woodland bird species (all species):

- Undertake restoration and revegetation to replace cohorts of trees where they have been removed from the landscape, particularly in areas adjacent to and connecting woodland remnants.
- Retain woody ground debris and large old trees that have the potential to contribute woody ground debris via the shedding of limbs.
- Identify sites where hollows are limiting and develop and implement strategies to increase hollow availability that have clear objectives and include monitoring, maintenance, and reporting requirements. Actions include nest box installation, the humane control of introduced species, and the protection of trees having the potential to develop hollows.
- Ensure populations remain connected by avoiding gaps greater than 100m between habitat patches and along linear remnants. Eliminate gaps through revegetation, either corridors or stepping stone plantings, focusing on important movement pathways.
- Target removal of weeds significantly compromising habitat values (e.g. invasive perennial grasses) and restore native vegetation. Care should be taken to avoid widespread removal of beneficial exotic woody vegetation without replacement and avoid non-target impacts of herbicides.
- Measure the abundance and impact of noisy miners on species populations and habitat, and implement appropriate management actions with demonstrated effectiveness to reduce the impacts of noisy miners if/where required. The preferred method for managing aggressive honeyeater impacts is through habitat modification (e.g. reduce the amount of edge and establish a structurally complex understorey).

- Undertake revegetation, using a diverse mix of locally appropriate native species, focussing on expanding and connecting areas of existing habitat. Where appropriate, establish new habitat patches in areas where native vegetation cover is lacking. Target the productive lower parts of the landscape, especially areas adjacent to streams, which may provide important drought refuges. To maximise these benefits, riparian plantings should be at least 50m wide.

- Conserve habitat containing large mature trees of key foraging species on fertile soil types as these provide productive foraging areas.

- Encourage natural regeneration of key foraging species in areas where grazing has degraded known habitat resulting in natural regeneration no longer occurring. Prioritise areas of fertile soils.

- Exclude grazing from suitable habitat, or reduce grazing intensity and regularity so that a diverse grass sward and scattered shrub layer is maintained, and seeding grasses are present throughout the year.

- Conduct hazard reduction burns so that the period between burns is long enough to enable the recruitment of key foraging species (usually greater than five years). Too frequent fire will adversely impact on natural regeneration of overstorey eucalypt species. Use crash grazing as a fuel reduction tool during years that a fire may cause high mortality in a recent recruitment event.

- Remove introduced fruit or berry producing plants (for example blackberry, hawthorn, cotoneaster, privet) that provide a food supply for nest predators such as pied currawongs.

- Promote the protection, maintenance and recruitment of Acacia woodland with mistletoe.

- Conduct strategic planting of acacia species (particularly *A. pendula* or *A. homalophylla*) to restore woodlands and connect fragmented patches.

- Protect ground layer and midstorey vegetation by implementing sensitive grazing practices and avoiding slashing or under scrubbing and promote retention of a floristically and structurally diverse and spatially variable understorey.

F12.5 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality. Habitat types of particular importance for these species include the Riverine Woodland and Grassy Woodland on Fertile Soils, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing araes of habitat management and effectively contribute to the viability of a regional wildlife corridor. Threatened woodland birds are susceptible to the effects of habitat loss and degradation. In the medium to long-term, 3,522.5 ha of Habitat restoration and corridor enhancement will likely provide important foraging and breeding habitat in the locality. Although these species all inhabit similar woodland and open forest habitats, they all have individual niches and micro-habitat preferences that must be catered for during restoration works.

Management measures for maintenance of suitable habitat

The main threats affecting the woodland birds involve the loss and degradation of habitat, through clearing for agriculture, mining and urban development.

Therefore, the most important management measure in the short-term is the protection of existing habitat management zones in BOAs, including the restricted access of site personnel and the general public. Furthermore, the staged clearing in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing those displaced individuals to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

In the long-term, an important management measure for the maintenance of suitable habitat for threatened woodland birds includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the successful restoration of a regional wildlife corridor will likely form important foraging and breeding habitat in the locality.

Another important management measure will be the appropriate planting of Habitat restoration and corridor enhancement zones, as to provide a mosaic of habitats in the regional wildlife corridor.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to threatened woodland birds and will be implemented within each BOA:

- active and passive revegetation
- selective thinning
- weed and pest control, including the control of foxes and feral cats
- management of unauthorised access and disturbance.

F12.6 Management actions and performance criteria

Table F-20 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for threatened woodland birds.

Table F-20 Management actions and performance criteria for threatened woodland birds

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and trees capable of providing suitable shelter and/ or breeding locations	All management zones[1]	Upgrade boundary fencing of all BOAs. Upgrade boundary fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other lands for agriculture zone.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B).

Objective	Management zone	Management action	Timing	Performance criteria
		clearing limits, necessary procedures and activities.		All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Biodiversity monitoring	All management zones[1]	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.
Habitat use	Habitat management zone	Annual biodiversity monitoring targeting threatened woodland birds (refer Section 7.2 of the main BMP document).	Annual	Monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat Management Zones show no observed significant decrease (i.e. greater than 40 %

Objective	Management zone	Management action	Timing	Performance criteria
				reduction sustained over three consecutive sampling periods) in bird species richness across the BOAs that cannot be attributed to natural variation against baseline monitoring site data. Continued records of threatened woodland birds within BOAs; particularly Speckled Warbler, Brown Treecreeper, Varied Sittella and Grey-crowned Babbler. Provision of annual biodiversity offset monitoring report detailing threatened species records.
Minimise application of pesticides/herbicides	All management zones[1]	Limit use of pesticides/herbicides to that absolutely necessary for effective use of agricultural lands	Annual	Document all use of pesticides/insecticides on agricultural lands that occur immediately adjacent to the wildlife corridor (i.e. those areas were excess use may affect insect abundance or availability for foraging insectivorous birds).
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

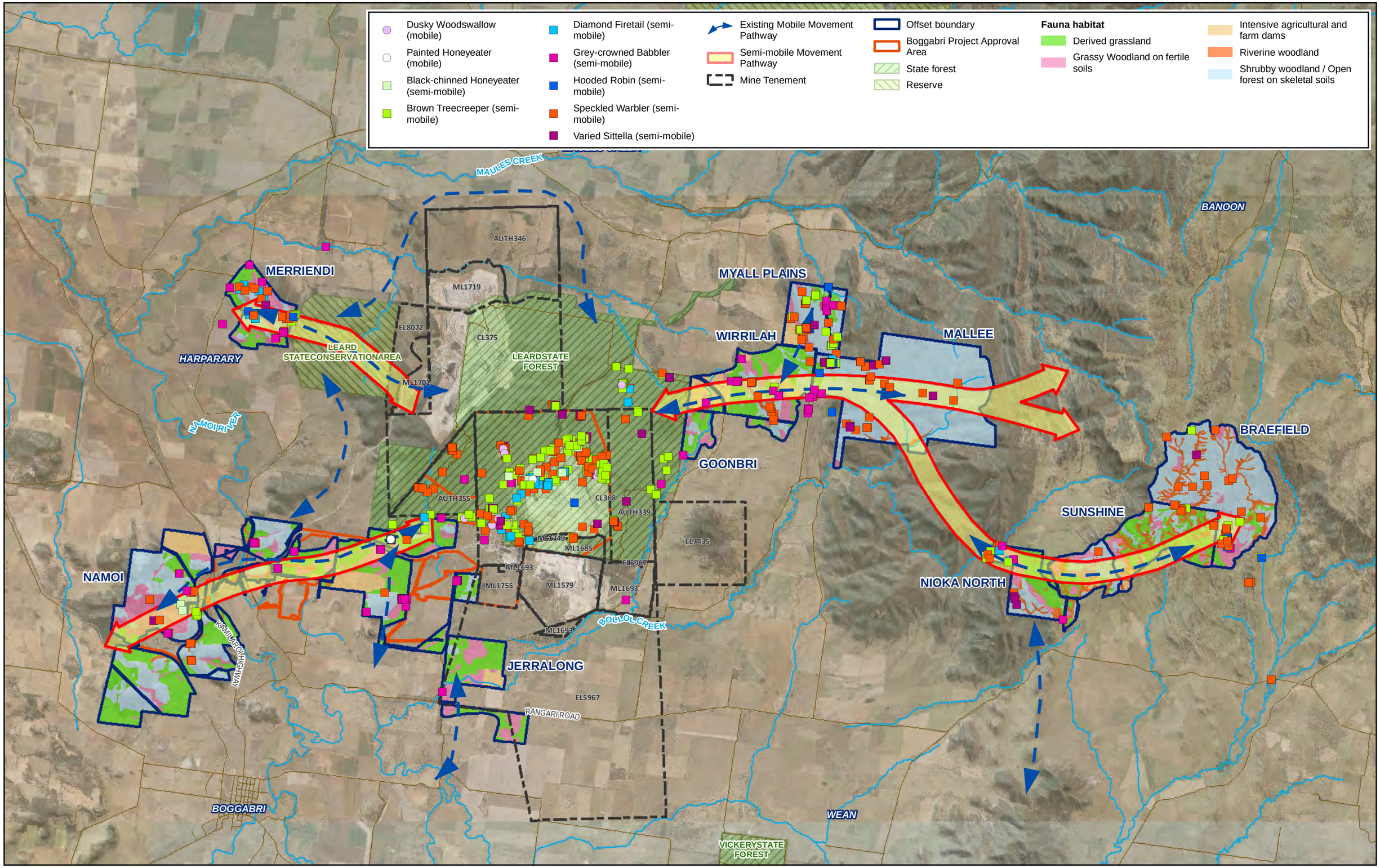
Objective	Management zone	Management action	Timing	Performance criteria
		Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for threatened grassland birds. Woodlands to contain areas of mid-storey shrubby trees and low shrubs to provide cover for small threatened passerines.		
Canopy growth	Habitat restoration and corridor enhancement	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species. Planting and regrowth to be managed to encourage areas of open woodland and clearings to serve as foraging habitat for threatened grassland birds. Woodlands to contain areas of mid-storey shrubby trees and low shrubs to provide cover for small threatened passerines.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F- 7.
Provision of supplementary habitat	Habitat restoration and corridor enhancement	Incorporation of ground timber in habitat restoration zones		Salvaged resources are reused and relocated to BOA habitat restoration zones and are in structurally good condition. Provision of ground timber as per criteria detailed in Table F-7: 10 years • 50 % of ground timber to be incorporated from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate withi criteria detailed in Table F-7. 15 years • 100 % of ground timber to be incorporated from a rehabilitation age of 15 years, or

Objective	Management zone	Management action	Timing	Performance criteria
				when regenerating canopy species are commensurate with criteria detailed in Table F- 7.
Inclusion of supplementary habitat features suitable for breeding	Habitat restoration and corridor enhancement zones	Incorporate nest boxes in habitat restoration zones until natural generation of tree hollows	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.
Long-term				
Maintenance, enhancement and	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM

Objective	Management zone	Management action	Timing	Performance criteria
restoration of fauna habitat			30+ years	2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for threatened woodland birds	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	>5 years	Annual monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat restoration zones and corridor enhancement zones show an observed increase in diurnal bird species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document). Records for threatened woodland birds utilising areas of restoration where canopy species are commensurate with milestones detailed in Table F- 8.

Objective	Management zone	Management action	Timing	Performance criteria
				Provision of annual biodiversity offset monitoring report detailing threatened species records.
Control of pest species, particularly foxes and cats	All management zones[1]	Complete strategic culling events or baiting programs as necessary	>2 years	Annual BOA Biodiversity Monitoring Report shows an overall reduction in pest animal species (particularly foxes and cats) and population sizes targeted by control measures implemented across all management zones across all BOAs (taking into consideration potential drought conditions and seasonal trends). Pest animal control is undertaken in accordance with relevant Codes of Practise and Standard Operating Procedures as detailed in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new pest occurrences are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-7

TITLE. THREATENED WOODLAND BIRDS

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F13 Little Lorikeet (*Parvipsitta pusilla*)

Little Lorikeet is listed as a Vulnerable species under the BC Act.

This parrot is endemic to Australia and is the smallest of the Australian lorikeets (NSW Scientific Committee 2009b). This species range extends along coastal eastern Australia from Cooktown to south-east South Australia. It inhabits forests and woodlands, with most associations occurring in dry, open eucalypt forest and woodlands. In NSW its range extends from the coast to the western slopes of the Great Dividing Range, with a western limit considered in the vicinity of Parkes, Dubbo and Narrabri (Pizzey & Knight 2007). While this species is not considered to be migratory, it is generally recognised to be nomadic (Higgins 1999), particularly concerning food availability, with irregular influxes occurring at any time. Long-term investigation of the breeding population on the north-western slopes indicates that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity (Courtney J. 2006).

Little Lorikeets are gregarious, foraging in small flocks and usually with other species of lorikeet, whereby they feed primarily on nectar and pollen in the tree canopy (NSW Scientific Committee 2009b). On the Western slopes of NSW, White Box and Yellow Box are considered to be important food resources for pollen and nectar respectively (Courtney J. 2006). Most breeding records come from the western slopes of NSW (where there has been extensive loss of habitat from historic clearing), with the breeding season extending from May to September (Higgins 1999). Nest hollows are located at heights of 2 m to 15 m (Courtney J. 2006) in smooth-barked eucalypts including Blakely's Red Gum. Long-term studies of this species on the north-west slopes of NSW (Courtney J. 2006) indicate that nest hollows are used traditionally, whereby the same hollow is known to be occupied for at least 29 years, although, not necessarily by the same individuals.

Over 50% of forest and woodlands in NSW have been cleared (Lunney 2004), coupled with the fact that most breeding records come from the western slopes, a region that has extensive habitat loss from historic clearing, the main threat that affects this species is the further loss and degradation of foraging and breeding habitat from land clearing (NSW Scientific Committee 2009b). Furthermore, nest hollows are not being recruited at a rate that compensates the loss of breeding habitat (Courtney J. 2006) and the loss of eucalypt woodland results in large reductions in food availability, particularly White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, an important habitat for Little Lorikeet, which is listed as Critically Endangered under the EPBC Act.

F13.1 Distribution of Little Lorikeet

The Little Lorikeet has been extensively recorded within the Project Boundary and has been recorded within each BOA (refer Table F-6 and Figure F-8).

F13.2 Threats

The following threats have been identified by NSW OEH for the Little Lorikeet:

- Given that large old Eucalyptus trees on fertile soils produce more nectar, the extensive clearing of woodlands for agriculture has significantly decreased food for the lorikeet, thus reducing survival and reproduction. Small scale clearing, such as during roadworks and fence construction, continues to destroy habitat and it will be decades before revegetated areas supply adequate forage sites.

- The loss of old hollow bearing trees has reduced nest sites, and increased competition with other native and exotic species that need large hollows with small entrances to avoid predation. Felling of hollow trees for firewood collection or other human demands increases this competition.

- Competition with the introduced Honeybee for both nectar and hollows exacerbates these resource limitations.

- Infestation of habitat by invasive weeds.

- Inappropriate fire regimes.

- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners.

- Climate change impacts including reduction in resources due to drought.

- Degradation of woodland habitat and vegetation structure due to overgrazing.

The main threat affecting the Little Lorikeet is the loss of high quality woodland on fertile soils that produce abundant nectar. It is likely that any restoration or revegetation attempt will require decades before any such areas will supply adequate foraging sites. The loss of old hollow-bearing trees is another important threat that affects this species, with tree hollow recruitment rates not adequately compensating the loss of such critical habitat resources. The continued loss of habitat trees places this species under competition with other species that require large hollows with small entrances to avoid predation. The felling of hollow-bearing trees for firewood further increases this competition.

F13.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Little Lorikeet:

- Undertake restoration and revegetation to replace cohorts of trees where they have been removed from the landscape, particularly in areas adjacent to and connecting woodland remnants.

- Protect ground layer and midstorey vegetation by implementing sensitive grazing practices and avoiding slashing or under scrubbing, and to promote the retention of a floristically and structurally diverse and spatially variable understorey in patches of woodland. Target in-perpetuity covenants or stewardship agreements to landholders with high quality remnant woodland habitat.

- Target removal of weeds significantly compromising habitat values (e.g. invasive perennial grasses) and restore native vegetation. Care should be taken to avoid widespread removal of beneficial exotic woody vegetation without replacement and avoid non-target impacts of herbicides.

- Measure the abundance and impact of noisy miners on species populations and habitat, and implement appropriate management actions with demonstrated effectiveness (e.g. direct control, habitat restoration) to reduce the impacts of noisy miners, if/where required.

- Identify sites where tree hollows are limiting and develop and implement a nest box strategy that has clear objectives and includes monitoring, maintenance, and evaluation of success.

- Undertake revegetation, using a diverse mix of locally appropriate native species, focussing on expanding areas of existing habitat, connecting isolated habitat patches (either through corridor or stepping stone plantings) or establishing additional habitat patches in landscapes with already existing, although insufficient, patches of suitable habitat. Areas with access to water, especially riparian areas, are particularly important, although care should be taken to ensure that riparian revegetation programs are sufficiently wide (minimum 50m wide).

F13.4 Maintenance of suitable habitat

Habitat management zone

The Little Lorikeet undertakes nomadic movements, which are presumably in response to seasonal and spatial flowering events. Habitat management zones reflect existing high quality fauna habitat that require little management in order for species uptake. Habitat management zones across all BOAs provide at least potential habitat for this species. In particular, areas of Grassy Woodland on Fertile Soils provide important foraging and nesting opportunities for this species, particularly as most observations are recorded in such habitat.

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs (refer Table F-9)., which together represent known and potential habitat for the Little Lorikeet, and likely represent important habitat in the locality (refer Table F-9).

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor. While the Little Lorikeet would not be affected by certain ecological characteristics of the proposed regional corridors, as with less mobile species (e.g. gap sizes, minimum width distances and potential barriers), in the medium to long-term, habitat restoration zones are likely to provide important foraging and potential nesting opportunities for this species.

Management measures for maintenance of suitable habitat

Long-term investigation of the breeding population of the Little Lorikeet on the north-western slopes of NSW indicate that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity (Courtney J. 2006). Therefore, in the long-term a mature canopy cover (equivalent to analogue sites) of specific food trees, including White Box, River Red Gum, Blakely's Red Gum, will provide an important foraging resource for this species in the locality.

Importantly, Little Lorikeets are known to use small hollows in smooth bark eucalypts. Therefore, inclusion of breeding opportunities in restoration areas is of great importance for

their continued survival in the locality. However, tree hollows are not likely to occur naturally in habitat restoration areas for a period greater than 50 years and more likely greater than 100 years; therefore, it is necessary to supplement Habitat restoration and corridor enhancement zones with nest boxes of a suitable size for potential uptake by the species.

The restoration of derived native grassland areas through regeneration of the existing soil seed bank is likely to provide limited habitat opportunities in the short-term (e.g. 5-10 years), with increased usage thereafter as canopy trees increase in size and maturity. It is recommended that nest boxes of an appropriate size be incorporated from a restoration age of 10 years. Canopy species at 10 years of age are considered to provide adequate height and canopy cover to provide suitable locations for the inclusion of nest boxes.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Little Lorikeet and will be implemented within each BOA:

- active and passive revegetation
- selective thinning
- retention and addition of habitat features, including natural hollows and nest boxes
- management of unauthorised access and disturbance.

F13.5 Management actions and performance criteria

Table F-21 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Little Lorikeet.

Table F-21 Management actions and performance criteria for Little Lorikeet

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and trees capable of providing suitable shelter and/ or breeding sites	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade boundary fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other lands for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities.	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Biodiversity monitoring	All management zones[1]	Complete annual biodiversity monitoring, as detailed in Section 7.2 of the main BMP document, to measure success of restoration in the long-term against baseline data and as compared with relevant BBAM 2014 benchmarks and Leard State Forest analogue sites (described in Section 7.3 of the main BMP document).	Annual	Biodiversity monitoring undertaken annually across the BOAs in accordance with the methodology detailed in Section 7.2.1.1 of the main BMP document. BOA Biodiversity Monitoring Report to include details of the current health and structure of all management zones across all BOAs against relevant BBAM 2014 benchmarks and analogue sites as required. Additionally, report will provide recommendations on management requirements to fulfil BOA performance and completion criteria detailed in this table. Native vegetation communities within BOAs meet at least 80% of lower BBAM 2014 benchmark values for corresponding vegetation types.

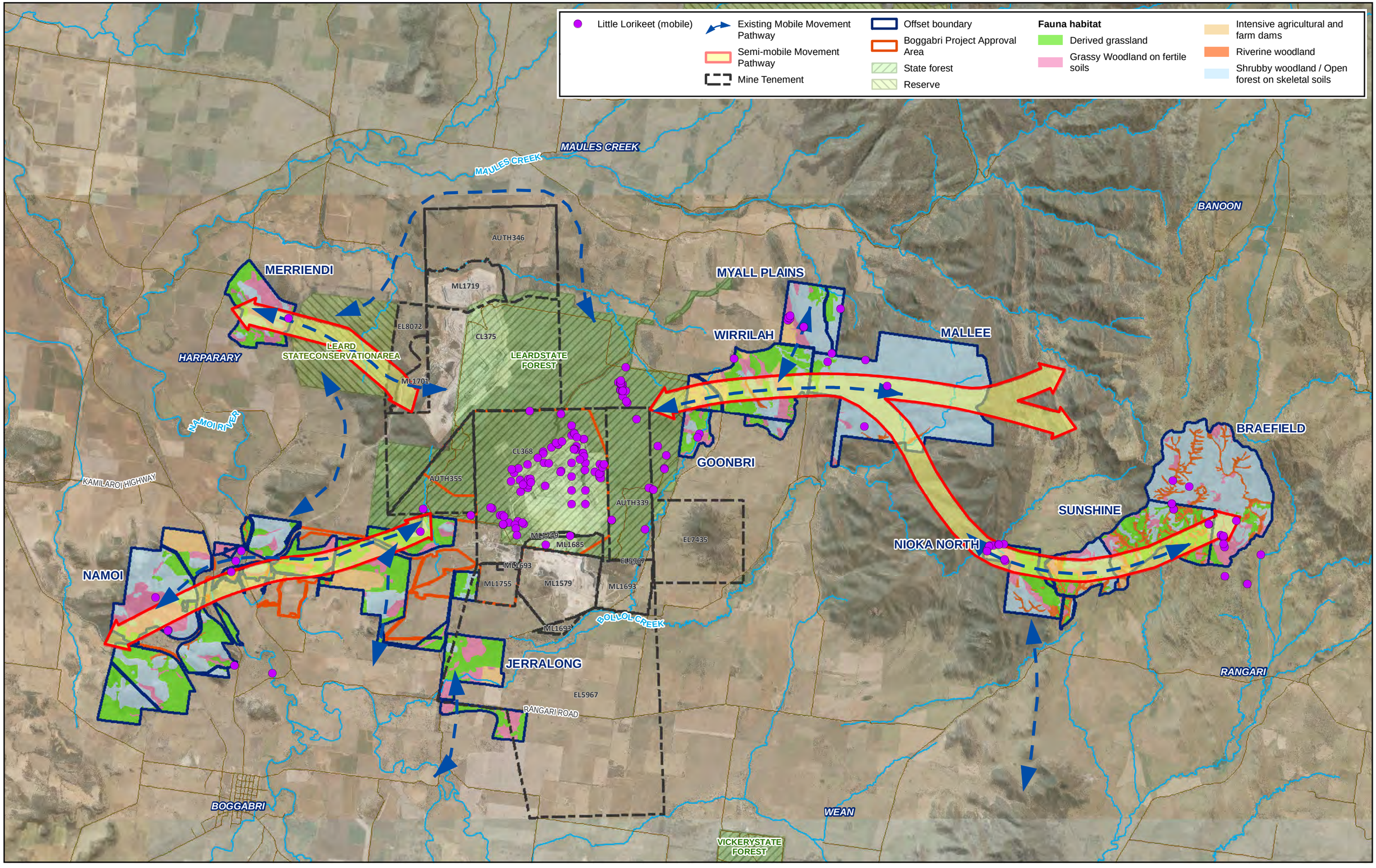
Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat management	Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	Annual	Monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat Management Zones show no observed significant decrease (i.e. greater than 40 % reduction sustained over three consecutive sampling periods) in bird species richness across the BOAs that cannot be attributed to natural variation against baseline monitoring site data. Continued records for Little Lorikeet within BOAs. Provision of annual biodiversity offset monitoring report detailing threatened species records.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F-7.
Provision of supplementary habiat features suitable for breeding	Habitat restoration and corridor enhancement	Incorporate nest boxes in restoration areas until natural generation of tree hollows	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.
Long-term				

Objective	Management zone	Management action	Timing	Performance criteria
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Little Lorikeet	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat restoration and corridor enhancement zones	Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	>15 years	Annual monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. Habitat restoration zones and corridor enhancement zones show an observed increase in diurnal bird species richness and/or abundance across the BOA, to within at least 80% of the benchmark for Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document). Records for Little Lorikeet utilising areas of restoration where canopy species are commensurate with milestones detailed in Table F-7 and Table F-8. Provision of annual biodiversity offset monitoring report detailing threatened species records.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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AUTHOR.	SuansriR
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DATE.	6/09/2018

APPENDIX F-8

TITLE. LITTLE LORIKEET

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F14 Swift Parrot (*Lathamus discolour*)

The Swift Parrot is listed as Critically Endangered under the EPBC Act and Endangered under the BC Act.

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

On mainland Australia, the main threat affecting this species is the loss of habitat through clearing for agriculture and urban and industrial development. During the breeding season and winter migration, collisions with wire netting fences, windows and cars, threaten this species, particularly where such obstacles are in close proximity to suitable habitat (Department of Environment and Conservation 2006).

F14.1 Distribution of Swift Parrot

Targeted surveys for threatened winter migrating birds completed in the Project Boundary to inform the continuation of mining biodiversity impact assessment failed to record this species, which was potentially attributable to a lack of flowering resources.

However, Swift Parrot was recorded in Leard State Forest and the Wirrilah BOA during surveys informing annual biological monitoring and this BMP, which coincided with *E. albens* (White Box) flowering profusely in the Project locality (refer Table F-6). Figure F-9 shows the spatial distribution of Parsons Brinckerhoff observations in the Project Boundary and BOAs.

F14.2 Threats

The following threats have been identified by the NSW OEH for the Swift Parrot:

- Habitat loss and degradation.
- Changes in spatial and temporal distribution of habitat due to climate change.
- Reduction in food resources due to drought.
- Competition for food resources.
- Collision mortality.
- Psittacine Beak and Feather Disease (PBFD).
- Fragmentation of woodland habitat.
- Infestation by invasive weeds.

- Inappropriate fire regimes.
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners.

The main threat affecting this species on mainland Australia is the continued destruction of habitat through clearing for agriculture, mining and urban development. Large trees on fertile soil provide abundant nectar, which is an important foraging resource for the Swift Parrot during their winter migration.

F14.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Swift Parrot:

- Protect large old trees, including from the effects of fire. Ensure the recruitment of large old trees by retaining medium-sized trees, facilitating regeneration, and undertaking replanting.
- Include locally occurring species that provide important food resources in revegetation programs where appropriate. Ensure that fuel reduction burns do not result in canopy scorch, which can reduce flowering in subsequent years. Manage aggressive honeyeater impacts through habitat modification (e.g. reduce the amount of edge and establish a structurally complex understorey).
- Monitor swift parrot distribution, abundance, and habitat use. Investigate knowledge gaps to improve the effectiveness of management actions, including understanding the phenology of key food species, determining movement strategies, patterns and pathways between regions, and modelling the impacts of climate change projections on the distribution and abundance of foraging habitat and resources.

F14.4 Maintenance of suitable habitat

Habitat management zone

While habitat management zones reflect areas of existing high quality fauna habitat that require little management in order for species uptake, the Swift Parrot is generally limited in its foraging opportunities to those eucalypt species that flower during their period of residence or areas with abundant lerp. Therefore, Swift Parrot is essentially limited to grassy woodland on fertile soil habitat, which is dominated by *E. albens*, as indicated by the spatial distribution of recent sightings. The apparent absence of this species in periods of low flowering abundance and their presence during a profuse flowering event highlights the cyclic nature of their migration to those areas that provide abundant foraging opportunities.

While *E. crebra* (Thin-leaved Ironbark) flowers from winter through to September, coinciding with Swift Parrots potential presence in the locality, its blossom is seldom of sufficient quantities to be considered an important foraging resource for this species.

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for the Swift Parrot on at least a cyclic basis (refer Table F-9).

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9). This will supplement existing areas of habitat management and over the mid to long-term will provide winter foraging sources for the Swift Parrot on at least a cyclic basis.

Management measures for maintenance of suitable habitat

Swift Parrots migrate to the Australian south-east mainland from March to October occurring in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (Department of Environment and Conservation 2006b). Further, it is known that local sightings can be cyclic and based on the presence of heavily flowering eucalypts. Therefore, in the long-term a mature canopy (equivalent to analogue sites) of specific food trees, particularly *E. albens* (White Box), will provide an important foraging resource for this species in the locality.

As Swift Parrots are non-breeding migrants to the mainland, the main management measures include the staged clearing of existing habitat (to minimise the extent of habitat loss in the locality in any one year) and successful restoration of Habitat restoration and corridor enhancement zones.

The restoration of derived native grassland areas through regeneration of the existing soil seed bank is likely to provide limited habitat opportunities in the short to medium term (e.g. 5-15 years), with increased usage thereafter as canopy tree species increase in size and maturity. Structural elements for the continued survival of this species in the locality should be sufficient for potential occurrence from a rehabilitation age of 10 to 15 years (e.g. potential foraging opportunities).

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Swift Parrot and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Management of unauthorised access and disturbance.

F14.5 Management actions and performance criteria

Table F-22 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Swift Parrot.

Table F-22 Management actions and performance criteria for Swift Parrot

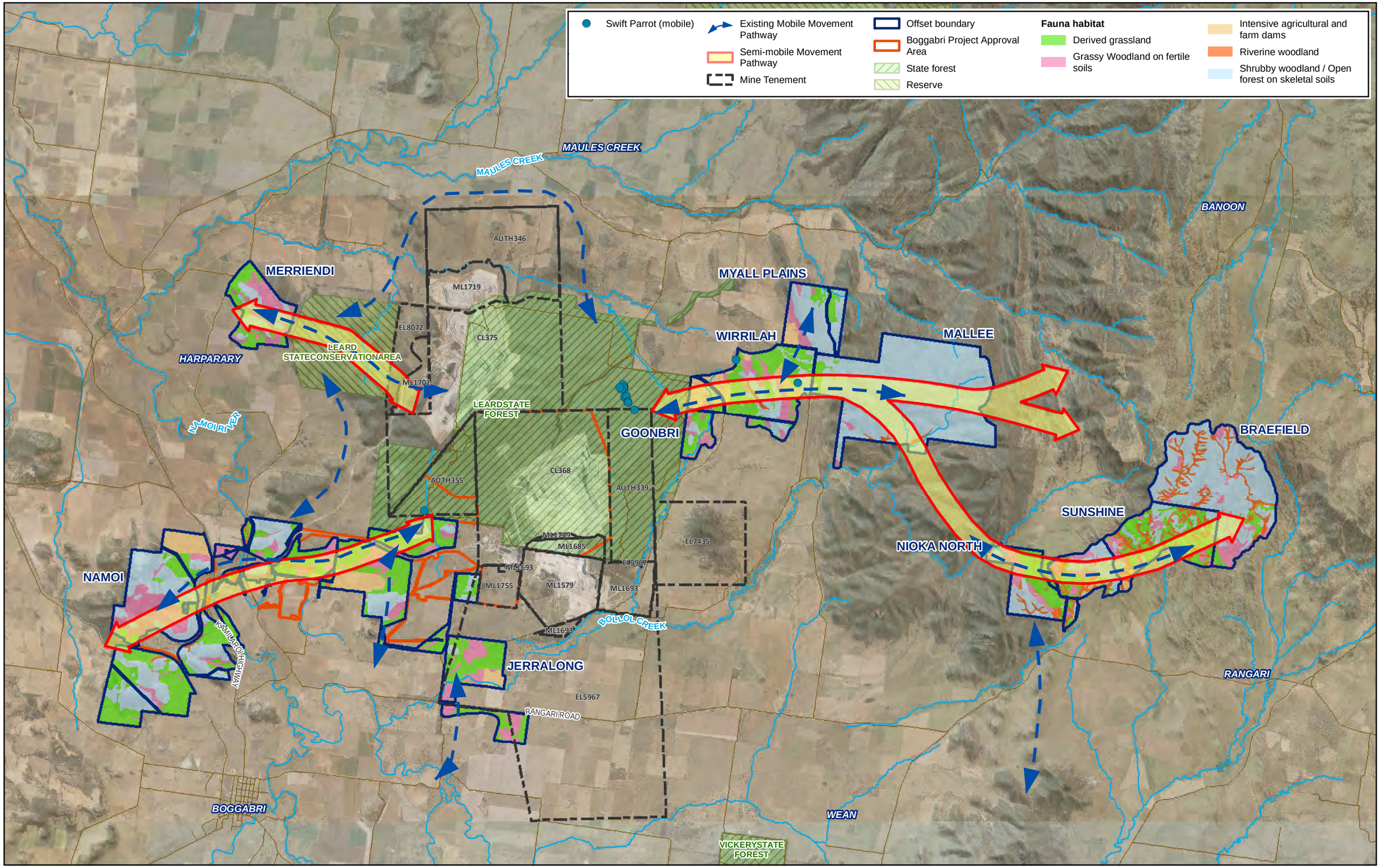
Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade boundary fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other lands for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities.	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Habitat use[2]	Habitat management	Annual biodiversity monitoring targeting threatened winter blossom nomads (refer Section 7.2.1.1 of the main BMP document).	Annual	Provision of annual biodiversity offset monitoring report detailing targeted threatened winter blossom nomad surveys and any threatened species recorded therein.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
		would commence at a density approximate to analogue sites.		
Canopy growth	Habitat restoration and corridor enhancement	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F- 7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Swift Parrot	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Habitat use[2]	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting threatened winter blossom nomads (refer Section 7.2 of the main BMP document).	>15 years	Provision of annual biodiversity offset monitoring report detailing targeted threatened winter blossom nomad surveys and any threatened species recorded therein.

Objective	Management zone	Management action	Timing	Performance criteria
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.
(2) Due to the cyclic nature of the Swift Parrots migration patterns, observations of this species are not likely to occur every season. Rather this may be observed locally during periods when *E. albans* is flowering profusely in the locality.



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Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-9

SWIFT PARROT

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F15 Spotted Harrier (*Circus assimilis*)

The Spotted Harrier is listed as a Vulnerable species under the BC Act.

The Spotted Harrier is widespread throughout most of the Australian mainland but individuals disperse widely, with this species being nomadic and irruptive in response to local conditions (food abundance). The Spotted Harrier occupies grassy open woodland, inland riparian woodland and grasslands, but is most commonly associated with native grassland and agricultural environments (NSW Scientific Committee – preliminary determination). This species builds a stick nest in open or remnant woodland and generally breeds from August to December or February to April (Pizzey & Knight 2007). The diet of the Spotted Harrier generally consists of terrestrial mammals (rodents), birds (quail) and reptiles (NSW Scientific Committee 2009c).

F15.1 Distribution of Spotted Harrier

The Spotted Harrier has been recorded in the Project Boundary and Namoi BOA and is predicted to occur in the remaining BOAs (refer Table F-6 and Figure F-10).

F15.2 Threats

The following threats have bene identified by the NSW OEH for the Spotted Harrier:

- Loss of foraging and breeding habitat, particularly that which affects prey densities
- Loss of mature trees from rural landscapes
- Secondary poisoning from the use of pindone in rabbit control
- Secondary poisoning from rodenticides
- Lack of knowledge of locations of key breeding habitat and breeding ecology and success.

The main threat to the Spotted Harrier is the clearing and degradation of foraging and breeding habitat, particularly where it affects prey densities. Other threats include the possibility of secondary poisoning from rodenticides and pindone used to control rabbits (NSW Scientific Committee 2009c). Therefore, any pest animal control plan considered for action in the Project Boundary and BOAs (particularly for the control of rabbits) will need to consider the required efficacy offset against this species. Recent sightings and potential home ranges of Spotted Harrier should be considered in the planning of pest control events.

Furthermore, Spotted Harriers typically forage on terrestrial mammals, birds and reptiles. Due to the decline of rabbits (following the spread of rabbit calicivirus disease), this species is increasingly dependent on native prey (NSW Scientific Committee final determination). Remaining native prey such as quail, pipits and songlarks, require appropriate groundcover, thus are sensitive to habitat degradation from grazing (NSW Scientific Committee final determination).

F15.3 Maintenance of suitable habitat

Habitat management zone

Although habitat management zones provide existing high quality habitat, such areas do not provide core habitat for this species. The Spotted Harrier is more commonly associated with native grassland and agricultural environments (NSW Scientific Committee – preliminary determination). However, Grassy Woodland on Fertile Soils, Riverine Woodland, Shrubby Woodlands/ Open Forest on Skeletal Soils and large remnant trees in agricultural environments provide potential nest locations for this species.

Habitat restoration and corridor enhancement zones

As the Spotted Harrier is more commonly associated with native grassland and agricultural environments, in the short-term, this species would likely utilise existing Habitat Restoration, Corridor Enhancement and Other Lands for Agriculture Zones. This equates to approximately 3,522.5 ha, which is likely to form core habitat for this species. However, as restoration activities take place across BOAs, such habitat will slowly deteriorate in terms of providing core foraging habitat. It is estimated that by a restoration age of 5 years, this habitat would no longer form core habitat for this species. Therefore, in the long-term, restoration activities would likely impact core foraging habitat as it transitions from derived native grassland or agricultural land to forested habitat. However, such areas cannot be discounted as providing habitat in itself, particularly nesting habitat.

Management measures for maintenance of suitable habitat

Spotted Harrier is most typically associated with agricultural environments, but also utilises Grassy Woodland on Fertile Soil and Riverine Woodland habitat types. While the restoration of derived native grassland and agricultural environments will typically remove areas of potential core foraging habitat, it is anticipated that required efficacy for restoration activities will provide further potential habitat for this species in the long-term. Moreover, a significant area of agricultural land will be retained within BOAs as well as other extensive agricultural environments in the locality

In the short-term, Habitat restoration and corridor enhancement zones potentially provide core foraging habitat for this species. However, in the medium-term, the restoration of such habitat will reduce this area of core foraging habitat. In the long-term, however, the restoration of Grassy Woodland on Fertile Soil and Riverine Woodland will provide potential habitat for this species.

Therefore, management measures particularly concern the effective restoration of Grassy Woodland on Fertile Soil and Riverine Woodland habitats across the BOAs. The restoration of derived native grassland though regeneration of the existing soil seed bank (supplemented by further planting of canopy species) will provide important habitat for this species in the locality. Furthermore, the structural elements for the continued survival of this species in the locality will be strengthened with an increase of ecotone habitat between Grassy Woodland on Fertile Soils and Riverine Woodland habitats and remaining agricultural environments.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Spotted Harrier and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Management of unauthorised access and disturbance
- Retention and addition of habitat features for prey species.

F15.4 Management actions and performance criteria

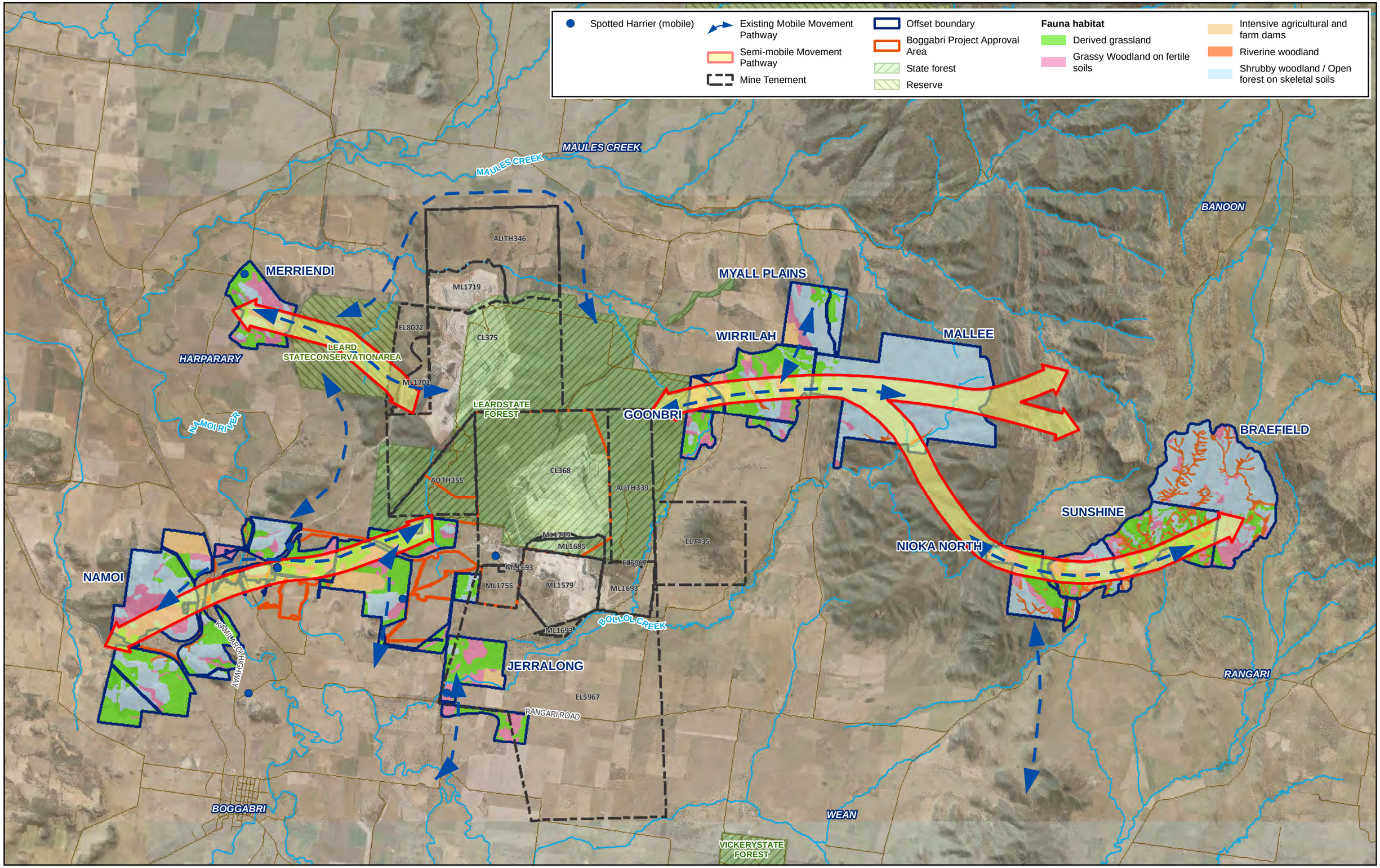
Table F-23 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Spotted Harrier.

Table F-23 Management actions and performance criteria for Spotted Harrier

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of suitable ground cover for Spotted Harrier prey species	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other lands for agriculture.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Habitat use	All management zones[1]	Annual biodiversity monitoring targeting diurnal birds and opportunistic sightings (refer Section 7.2 of the main BMP document).	<1 year	Continued observations/ records of Spotted Harrier within the BOAs (i.e. Riverine Woodland in proximity to the Namoi River).
Medium-term				
Maintenance of suitable core foraging areas	All management zones	Ensure appropriate ground cover (particularly derived native grassland) maintained in restoration zones Retained agricultural land will provide known and potential foraging habitat in the locality	>5 years	Maintenance of appropriate ground cover (particularly native grassland) that provides suitable habitat for native prey of the Spotted Harrier. This will be particularly targeted along existing habitat in proximity to the Namoi River and where restoration zones border agricultural tenures
Long-term				

Objective	Management zone	Management action	Timing	Performance criteria
Provision of suitable habitat for Spotted Harrier	All management zones[1]	Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	Annual	Records for Spotted Harrier using BOAs in areas with suitable ground-cover habitat (particularly native grassland) that provide habitat for native prey of the Spotted Harrier. This will be particularly targeted along existing habitat in proximity to the Namoi River and where restoration zones border other lands for agriculture (such as in the Namoi BOA, Merriendi BOA, Wirrilah BOAand Myall Plains BOA).
Fire control	All management zones	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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APPENDIX F-10

TITLE. SPOTTED HARRIER

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F16 Black-necked Stork (*Ephippiorhynchus asiaticus*)

The Black-necked Stork is listed as Endangered under the BC Act.

This species is widespread across coastal and sub-coastal north and eastern Australia from Port Hedland in Western Australia to the Central Coast in NSW (Pizzey & Knight 2007), although heading south from the Queensland border, this species is increasingly uncommon. This species has been recorded as far south as Victoria and inland to the Macquarie marshes, although it is only considered a vagrant in such locations (Pizzey & Knight 2007). On the southern and western limits of this species range, individual records have declined significantly, with only occasional records occurring on the south coast or west of the Great Dividing Range (NSW Scientific Committee 1998).

Black-necked Storks are generally considered sedentary (Pizzey & Knight 2007) but some individuals may travel long distances and have can be recorded outside their normal range (NSW Scientific Committee 1998).

This species inhabits permanent freshwater wetlands, swamps, shallow floodwaters and adjacent grasslands. It can also be found on tidal mudflats, mangroves, estuaries, farm dams, sewage ponds, irrigated lands and open woodland. This species feeds in shallow water on prey such as fish, frogs, eels and turtles (NSW Scientific Committee 1998).

Black-necked Stork breeds during late summer in the north of its range and early summer further south. Nests are large and made high and exposed in tall live or dead tree in proximity to a freshwater swamp (NSW Scientifc Committee 1998; NSW Scientific Committee 1998). In northern NSW this species continues to breed river valleys, although few nests occur within each valley.

F16.1 Distribution of Black-necked Stork

This species has been recorded in the Project Boundary and is predicted to occur in the Namoi BOA (refer Table F-6 and Figure F-11).

F16.2 Threats

The following threats have been identified by NSW OEH for the Black-necked Stork:

- Powerlines, especially close to wetlands or over floodplains, are a significant cause of mortality of Storks and one of the most critical threats to the species in NSW.
- Modification or degradation of wetlands through changes in natural water flows. It is important to maintain or reintroduce flows to provide wetland habitats suitable for foraging by Storks as they require large amounts of vertebrate prey from such habitats.
- Loss of wetland habitat through clearing and draining for development.
- Loss of key habitat as a result of wetland drainage for flood mitigation and agricultural development.
- Degradation of wetland habitats through pollution.

- Loss of paddock trees used for nesting.
- Degradation of wetlands as a result of salinity.

The close proximity of power lines to wetland habitat or that extend over floodplains is a significant cause of mortality and is considered the most critical threat to this species in NSW. Furthermore, the modification and/ or loss of wetland habitat and floodplains (including changes to natural flow of water, clearing, degradation and drainage) also threaten this species, and while artificial water sources do provide new areas of habitat, such habitat is often sub-optimal for Black-necked Stork (NSW Scientifc Committee 1998). This is particularly important as this species requires large amounts of vertebrate prey from wetland habitat. Removal of remnant vegetation and the loss of paddock trees are regarded as one of the major threats to this species. The scarcity of nest sites also increases competition for those available with other species of bird.

F16.3 Recovery actions

No recovery actions have been identified for the Black-necked Stork by the NSW OEH do date, however in the interim the following applicable management actions have been identified:

- Restore natural hydrological regimes to freshwater wetlands. Maintain existing hydrological regimes. Do not fill or drain wetlands. Retain and protect native vegetation in and around wetlands. Restore degraded wetlands.
- Exclude stock, reducing grazing pressure and controlling weed species at important sites. Avoid placing powerlines over or near wetlands and/or nest sites.
- Reduce nutrient runoff into wetlands known to be used by Black-necked Storks. Avoid the use of herbicides and pesticides near or in wetlands.
- Control feral animals near nesting sites.

F16.4 Maintenance of suitable habitat

Habitat management zone

Riverine Woodland within the BOAs provide a number of small to medium sized natural soaks, which provide an important habitat resource for the Black-necked Stork. Within the BOAs, approximately 596.3 ha of the Riverine Woodland habitat type is contained within habitat management zones. The majority of these areas occur within the vicinity of the Namoi River and along major drainage lines, such as Bolar Creek.

Habitat restoration and corridor enhancement zones

Habitat restoration and corridor enhancement zones contain 94.0 ha of Riverine Woodland.

Management measures for maintenance of suitable habitat

All known and potential habitat for the Black-necked Stork within the BOAs is contained within habitat management zones, and as such, short-term management measures are focused on the protection of these areas. Measures to be implemented within habitat management zones that will benefit this species include the upgrade of existing fencing,

restricting access from unauthorised personnel, managing existing erosion and monitoring high risk areas, the exclusion of livestock, weed and pest management and the retention and addition of habitat features.

In the long-term, Riverine Woodland will be restored within the Habitat restoration and corridor enhancement zones through active and passive regeneration and through the implementation of the abovementioned management actions.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Black-necked Stork and will be implemented within each BOA:

- Active and passive revegetation
- Erosion management and monitoring
- Grazing management
- Management of unauthorised access and disturbance.

F16.5 Management actions and performance criteria

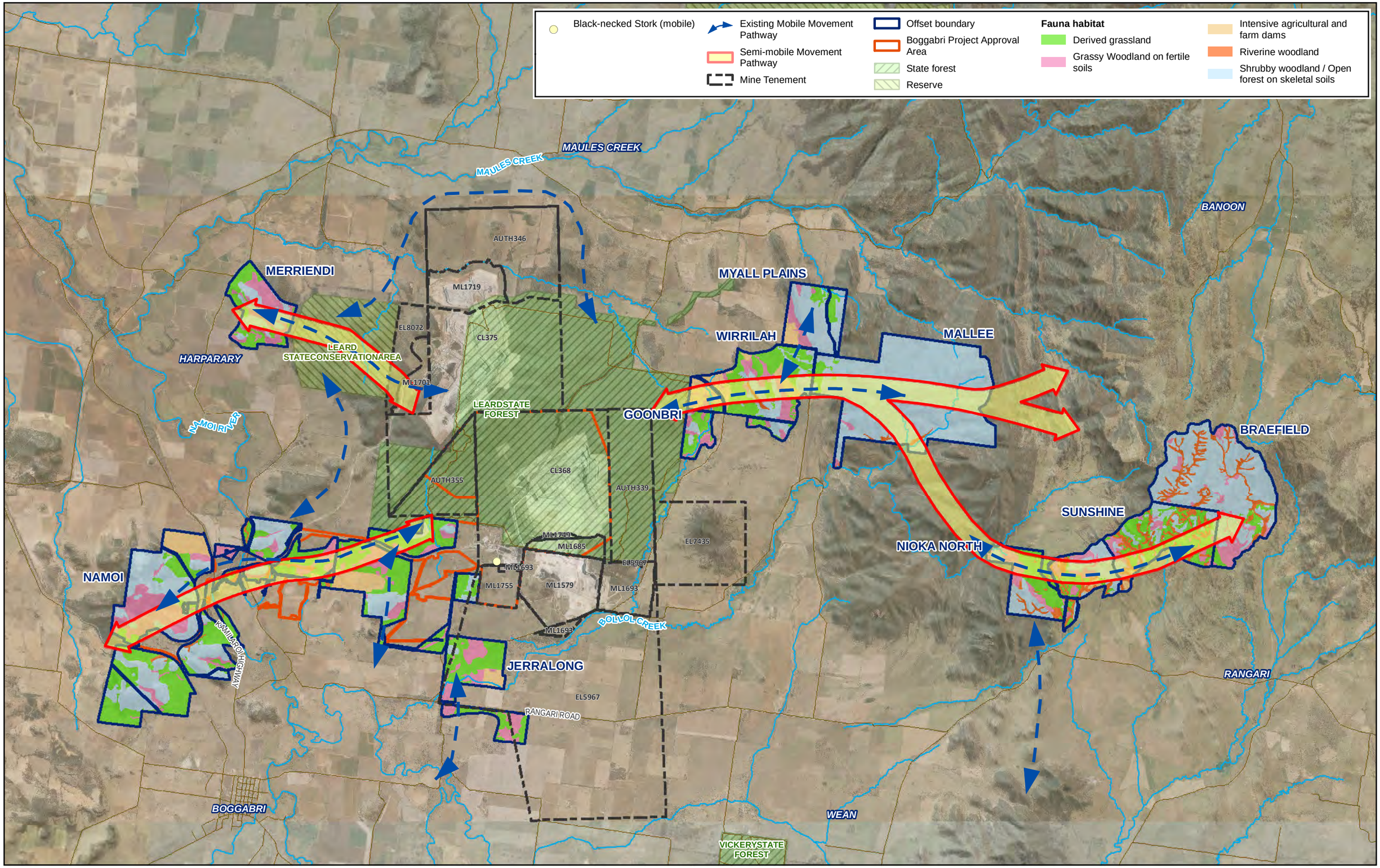
Table F-24 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Black-necked Stork.

Table F-24 Management actions and performance criteria for Black-necked Stork

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and large trees within the vicinity of waterbodies capable of providing suitable nest locations	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs as detailed in Appendix E. Upgrade fencing around land designated as other lands for agriculture zone.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.

Objective	Management zone	Management action	Timing	Performance criteria
Maintenance of suitable habitat for the Black-necked Stork	Habitat management	Complete annual biodiversity monitoring to measure success of habitat management of riverine woodland in the long-term against baseline data from habitat management zones of the BOAs (refer Section 7.2of the main BMP document).	Annual	Monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. 100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Long-term				
Provision of suitable habitat for the Black-necked Stork	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring. Annual biodiversity monitoring targeting diurnal birds (refer Section 7.2 of the main BMP document).	20 years 30+ years	Annual monitoring of diurnal bird species richness and abundance completed as part of the BOA monitoring program. 100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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APPENDIX F-11

BLACK-NECKED STORK

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F17 Superb Parrot (*Polytelis swainsonii*)

The Superb Parrot is listed as Vulnerable under the EPBC Act and BC Act.

This species is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. It is estimated that there are less than 5000 breeding pairs left in the wild.

The species Inhabits Box Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. It nests in small colonies and is known to forage up to 10 km from nesting sites, primarily in Box Gum Woodland. The species feeds in trees and understorey shrubs and on the ground, with a diet consisting grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain (Office of Environment and Heritage, 2012).

F17.1 Distribution of Superb Parrot

The Superb Parrot has not been recorded within the Project Boundary or BOAs, however these areas provide potential habitat for this species (refer Table F-6).

F17.2 Threats

The following threats have been identified by the NSW OEH for the Superb Parrot:

- Loss of living and dead hollow bearing trees
- Loss of breeding and foraging habitat
- Loss of breeding and foraging habitat
- Poor regeneration of nesting trees and food resources
- Loss of habitat from private native forestry activities
- Feeding on grain spills and subsequently being struck by vehicles
- Loss of hollows to feral bees and native and exotic hollow-nesting birds
- Illegal trapping which can also result in the destruction of hollows
- Illegal shooting of birds in orchards
- Lack of knowledge of population trends in the Superb Parrot
- Lack of knowledge of key flight paths and corridors of the Superb Parrot
- Loss of habitat trees from fire damage during hazard reduction and stubble burns

- Lack of knowledge of breeding ecology and success of the Superb Parrot
- Competition with Noisy Miners for breeding and foraging habitat and resources.

F17.3 Recovery actions

The following applicable recovery actions have been identified by the NW OEH for the Superb Parrot:

- Retain living and dead paddock trees and plant or direct seed appropriate local eucalypt species, particularly white box, yellow box, Blakely's red gum and river red gum, to replace these trees in the long-term. Ideally, planted paddock trees should be spaced no more than 50m apart to provide connectivity for other fauna species.
- Report illegal shooting or trapping of superb parrots to Environment Line (131 555).
- Protect living and dead hollow-bearing trees from fire.
- Supplement the number of natural hollows with artificial hollows. These may be created in living or dead eucalypts without natural hollows using a chainsaw. Alternatively, appropriate nest boxes may also be used, provided that they are monitored for use by superb parrots and not exotic fauna and they are maintained in the long-term.
- Protect paddock trees and ensure their replacement over the long term through planting and direct seeding
- Protect known and potential remnant superb parrot habitat, particularly Box Gum, box-ironbark and weeping myall woodland and river red gum riparian gallery forest, with large hollow-bearing trees, native shrubs such as wattles, hop bushes and saltbushes and native grasses and manage to allow ongoing regeneration of local native trees, shrubs and groundcover plants.
- Restore superb parrot habitat in strategic locations close to known habitat and movement corridors, including riparian areas, using appropriate local tree, shrub and ground cover species. The planting of wattles, hopbush, saltbush and native grasses will provide important foraging habitat.
- Erect warning signs on roads where superb parrot road kill events are known to occur.

F17.4 Maintenance of suitable habitat

Habitat management zone

BOAs currently provide approximately 7,120.0 ha of habitat management zones that provide habitat attributes important for this species including, hollow-bearing trees, fallen timber and high native species diversity (refer Table F-9). Habitat of particular importance includes areas dominated by White Box due to the generally high abundance of tree hollows.

Habitat restoration and corridor enhancement zones

In the medium to long-term it is estimated that an additional 3,522.5 ha of habitat restoration and corridor enhancement will supplement existing habitat management zones and effectively contribute to the viability of a local and regional wildlife corridor. Although the Superb Parrot is not necessarily affected by localised small-scale fragmentation of habitat, the species is susceptible to the effects of habitat loss, particularly concerning the loss of critical resources (i.e. hollow-bearing trees) and degradation of habitat through agricultural practices.

The restoration of areas of derived native grassland and agricultural land (habitat restoration and corridor enhancement zones) will likely provide suitable habitat (including potential breeding habitat) and movement pathways for this species in the locality. Furthermore, as the Superb Parrot typically feeds on grass seeds and herbaceous plants, and is often associated with ecotone or edge habitat (i.e. edges of eucalypt woodland and adjoining clearings), a mosaic of habitats in the wildlife corridor will provide important microhabitat characteristics for this species.

In the short-term, early shrub and tree growth, supplemented with fallen timber will likely provide sufficient habitat complexity to afford safe foraging opportunities. Initial careful plant spacing is required to provide open foraging areas with increased shelter offered by maturing canopy species. It is estimated that following 15 years of restoration, stabilised habitat usage will occur as open foraging areas continue to exist in a mosaic structure, potentially with established breeding territories, where nest boxes are provided as a supplementary habitat feature.

Management measures for maintenance of suitable habitat

The main threats affecting the Superb Parrot involve the loss of habitat, including critical resources such as hollow-bearing trees and the degradation of habitat. Therefore, the most important management measure in the short-term is the protection of existing habitat management zones in the BOAs, including restricting access of site personnel and the general public, particularly concerning the removal of standing dead trees for fire wood. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing any displaced individuals (from established breeding territories) to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

Due to extensive habitat destruction in the locality and wider catchment area, smaller fragments and riparian strips of remnant trees effectively occur as the last inhabitable areas for the Superb Parrot. Therefore, in the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the successful restoration of a regional wildlife corridor will likely form important foraging and breeding habitat in the locality. As the Superb Parrot is critically limited by the availability of tree hollows, which will not naturally occur in areas of restoration (Habitat restoration and corridor enhancement zones) for a period greater than 50 years, and more likely greater than 100 years, restoration areas will require the provision of appropriately sized nest boxes that may offer potential breeding habitat in the short to medium-term.

Another important management measure will be the appropriate planting of Habitat restoration and corridor enhancement zones, as to provide a mosaic of habitats in the regional wildlife corridor.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Superb Parrot and will be implemented within each BOA:

- Active and passive revegetation
- Retention and addition of habitat features, including natural hollows and nest boxes
- Selective thinning
- Weed and pest control, including the control of foxes and feral cats
- Grazing management
- Management of unauthorised access and disturbance.

F17.5 Management actions and performance criteria

Table F-25 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Superb Parrot.

Table F-25 Management actions and performance criteria for Superb Parrot

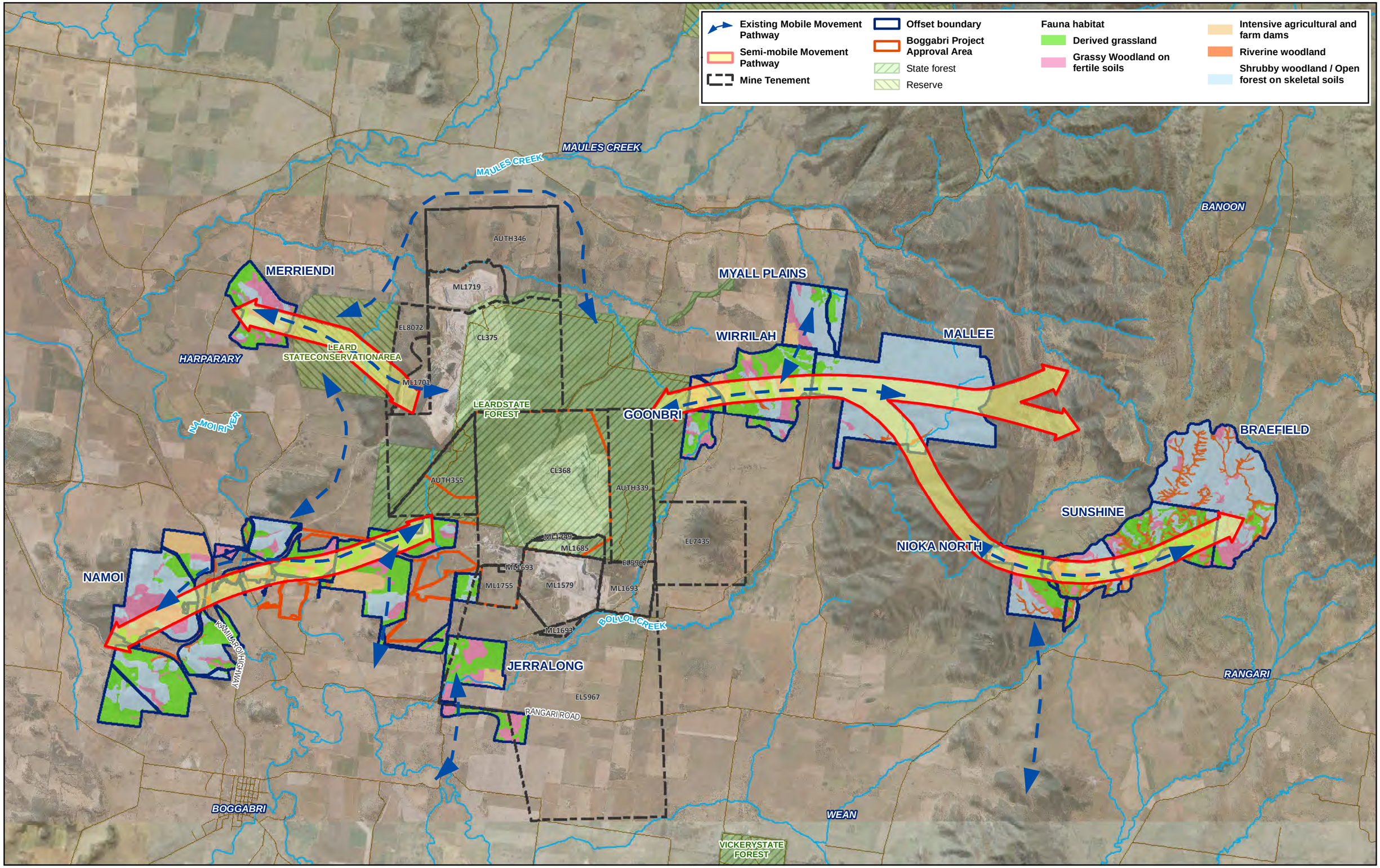
Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities.	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Habitat use	Habitat management and habitat restoration	Annual biodiversity monitoring targeting threatened winter birds (refer Section 7.2 of the main BMP document).	Annual	Provision of annual biodiversity offset monitoring report detailing targeted threatned winter bird surveys and any threatened species recorded therein.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
		species would commence at a density approximate to analogue sites.		
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F- 7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Superb Parrot	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting threatened winter blossom nomads (refer Section 7.2 of the main BMP document).	>15 years	Provision of annual biodiversity offset monitoring report detailing targeted threatned winter bird surveys and any threatened species recorded therein.
Control of pest species, particularly foxes and cats	All management zones[1]	Complete strategic culling events or baiting programs as necessary	>2 years	Annual BOA Biodiversity Monitoring Report shows an overall reduction in pest animal species (particularly foxes and cats) and population sizes targeted by control measures implemented across all management zones across all BOAs (taking into consideration potential drought conditions and seasonal trends). Pest animal control is undertaken in accordance with relevant Codes of Practise and Standard Operating Procedures as detailed in the Weed and Pest Management Strategy (refer to Appendix C). Where significant or new pest occurrences are identified, a review has been undertaken and appropriate control measures are implemented within one year of identification.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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APPENDIX F-12

TITLE. SUPERB PARROT

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F18 Regent Honeyeater (*Anthochaera Phrygia*)

The Regent Honeyeater is listed as Critically Endangered under the EPBC Act and Critically Endangered under the BC Act.

This species mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW, the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years, flocks converge on flowering coastal woodlands and forests.

The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.

The Regent Honeyeater is a generalist forager, feeding on the nectar from a wide range of eucalypts and mistletoes. During breeding between July and January, the female constructs an open cup-shaped nest of bark, grass, twigs and wool. Two or three eggs are laid and incubated by the female for 14 days. Nestlings are brooded and fed by both parents at an average rate of 23 times per hour and fledge after 16 days. Fledglings fed by both parents 29 times per hour (Office of Environment and Heritage, 2012).

F18.1 Distribution of Regent Honeyeater

The Regent Honeyeater has not been recorded within the Project Boundary or BOAs, but is considered likely to occur based on the suitability of habitat and proximity to Bundarra-Barraba, which is one, of the important locations where this species is concentrated in NSW (NSW Department of Environment and Climate Change 2009e).

F18.2 Threats

The following threats have been identified by the NSW OEH for the Regent Honeyeater:

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands.
- Continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments, timber gathering and residential developments.
- Suppression of natural regeneration of overstorey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly impacted by overgrazing.

- Inappropriate forestry management practices that remove large mature resource-abundant trees. Firewood harvesting in Box-Ironbark woodlands can also remove important habitat components.
- Competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds.
- The small population size and restricted habitat availability make the species highly vulnerable to extinction via stochastic processes.
- Egg and nest predation by native birds.

F18.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Regent Honeyeater in the Bundarra-Barraba management area (Gunnedah/Gwydir/Tamworth Region):

- Ensure grazing regime is appropriate for the species.
- Ensure land management is sympathetic to the long term requirements of the species.
- Track species abundance/condition over time.
- Conservation and restoration of key habitat for the Regent Honeyeater is a priority recovery action for this species.

F18.4 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Of particular importance for this species are the Riverine Woodland and Grassy Woodland on Fertile Soils habitat types, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones and are dominated by tree species known to be associated with the Regent Honeyeater, including *E. albens*, *E. crebra* and *Callitris glaucophylla*.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-9), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor. The Regent Honeyeater is susceptible to the effects of habitat loss and degradation. In the medium to long-term, 3,522.5 ha of habitat restoration and corridor enhancement will likely provide important foraging and breeding habitat in the locality.

Habitat opportunities for this species within restoration zones (habitat restoration and corridor enhancement zones) will be limited due to a lack of canopy values for at least 15 years from the commencement of active and passive regeneration. Following the establishment of sufficient canopy cover, these areas will provide foraging and breeding habitat opportunities for seasonal use by the Regent Honeyeater.

Management measures for maintenance of suitable habitat

The main threats affecting the Regent Honeyeater involve the loss and degradation of habitat for agriculture and residential development. Therefore, the most important management measure in the short-term is the protection of existing habitat management zones in BOAs, including restricting the access of site personnel and the general public. Furthermore, the staged clearing in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing any displaced individuals to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

In the long-term, an important management measure for the maintenance of suitable habitat for the Regent Honeyeater includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the successful restoration of a regional wildlife corridor will likely form important foraging and breeding habitat in the locality. Another important management measure will be the appropriate planting of Habitat restoration and corridor enhancement zones, as to provide a mosaic of habitats in the regional wildlife corridor.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Regent Honeyeater and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Weed and pest control, including the control of foxes and feral cats
- Management of unauthorised access and disturbance.

F18.5 Management actions and performance criteria

Table F-26 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Regent Honeyeater.

Table F-26 Management actions and performance criteria for Regent Honeyeater

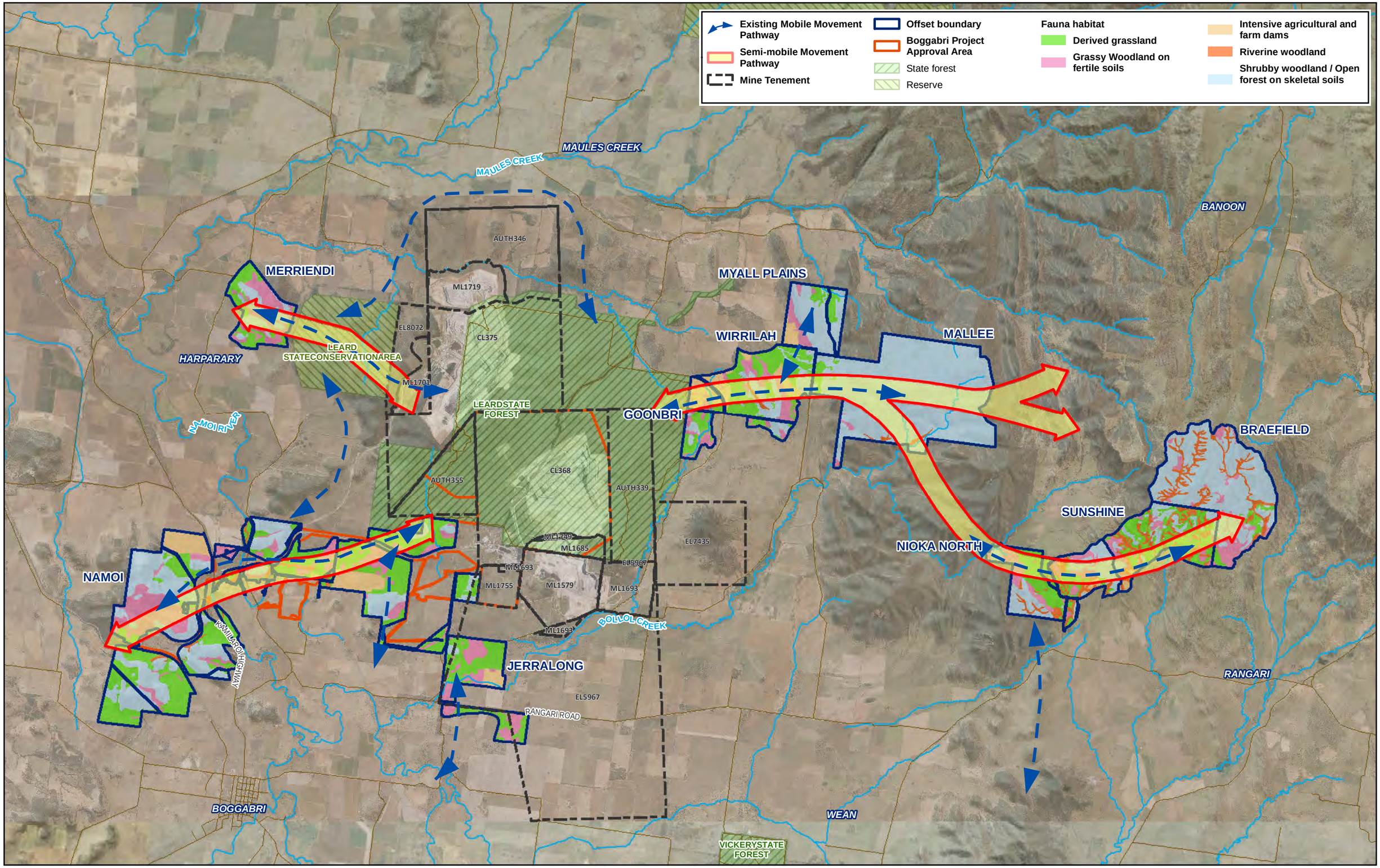
Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of potential habitat	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade boundary fencing around other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities.	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Habitat use[2]	Habitat management	Annual biodiversity monitoring targeting threatened winter blossom nomads (refer Section 7.2 of the main BMP document).	Annual	Provision of annual biodiversity offset monitoring report detailing targeted threatened winter blossom nomad surveys and any threatened species recorded therein.
Minimise application of pesticides/ herbicides	All management zones[1]	Limit use of pesticides/herbicides to that absolutely necessary for effective use of agricultural lands	Annual	Document all use of pesticides/insecticides on agricultural lands that occur immediately adjacent to the wildlife corridor (i.e. those areas were excess use may affect insect abundance or availability for foraging insectivorous birds.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
		expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites.		
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species. Planting and regrowth to be managed to encourage areas of open woodland and clearings to allow for greater uptake of mistletoe (*Amyema* sp.)	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F- 7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).

Objective	Management zone	Management action	Timing	Performance criteria
Provision of suitable habitat for Regent Honeyeater	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting threatened winter blossom nomads (refer Section 7.2 of the main BMP document).	>15 years	Provision of annual biodiversity offset monitoring report detailing targeted threatened winter blossom nomad surveys and any threatened species recorded therein.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.
(2) Alhough the Regent Honeyeater is a generalist forager, it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. They can undertake large-scale nomadic movements in the order of hundreds of kilometres in response to spatial and temporal flowering patterns. Accordingly, observations of Regent Honeyeater may be observed locally during periods when *E. albans* is flowering profusely in the locality.



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MINE NAME.	2171706A_GIS_BMP016_A2
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DATE.	6/09/2018

APPENDIX F-13

TITLE. REGENT HONEYEATER

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F19 Spotted-tailed Quoll (*Dasyurus maculatus*)

The Spotted-tailed Quoll is listed as Endangered under the EPBC Act and Vulnerable under the BC Act.

Spotted-tailed Quoll occurs in a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline (Belcher 2003). Preferred habitat for Spotted-tailed Quoll includes dry and moist sclerophyll forests where they nest in hollow-bearing trees, fallen logs, burrows, small caves, rock crevices, boulder-fields and rocky-cliff faces and will feed in nearby cleared areas (Edgar & Belcher 1998). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas (Triggs 2004), although individuals require large areas of relatively intact vegetation through which to forage.

Spotted-tailed Quoll is mostly nocturnal although it will hunt during the day. On cold winter days they often bask in the sun. It spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds. This species consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, reptiles, bandicoots, rabbits and insects. It also eats carrion and takes domestic fowl (Edgar & Belcher 1998).

Females breed only once a year unless they fail to find a mate or lose their litter early, at which time they will try to breed again. Breeding occurs in early winter with females giving birth to up to six young after a gestation period of 21 days. The young leave the pouch at seven weeks and are left in the den when too large to carry on the mothers back (Gibbons & Lindenmayer 2000). They are independent at five months, with sexual maturity reached at one year of age (Kortner *et al.* 2004). Dens are shared by family groups and are aggressively defended by both males and females. Females occupy large home ranges up to about 750 ha and males up to 3,500 ha and they usually traverse their ranges along densely vegetated creeklines. This species has been recorded moving more than two kilometres overnight (Claridge *et al.* 2005).

Spotted-tailed Quolls use ‘latrine sites’, often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals. Latrine sites can be recognised by the accumulation of the sometimes characteristic ‘twisty-shaped’ faeces deposited by animals (Triggs 1996).

The Spotted-tailed Quoll is found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common (NSW National Parks and Wildlife Service 1999a).

F19.1 Distribution of Spotted-tailed Quoll

The Spotted-tailed Quoll has not been recorded within the Project Boundary or BOAs, however these areas provide potential habitat for this species (refer Table F-6).

F19.2 Threats

The following threats have been identified by the NSW OEH for the Spotted-tailed Quoll:

- Loss, fragmentation and degradation of habitat.
- Competition with introduced predators such as cats and foxes.
- Deliberate poisoning, shooting and trapping, primarily in response to chicken predation.
- Roadkill.

F19.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Spotted-tailed Quoll:

- Conserve old-growth forest stands and other areas of known habitat.
- Identify and target restoration and revegetation projects at areas where connectivity between large areas of known habitat is compromised, with the aim of increasing the width, condition and security of critical landscape links.
- Implement (or augment coordinated), cross-tenure, landscape scale predator control programs in areas where significant populations of spotted-tailed quoll are known to occur, and monitor populations of the target introduced predator.

Monitor significant spotted-tailed quoll populations to investigate the impact of fox and wild dog baiting.

F19.4 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality. Habitat types of particular importance for this species include the Riverine Woodland and Grassy Woodland on Fertile Soils, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement withint the BOAs (refer Table F-9), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor.

The restoration of derived native grassland areas through active revegetation and regeneration of the existing soil seed bank is likely to provide limited habitat opportunities in the short to medium term (e.g. 5-10 years), with increased usage thereafter as canopy tree species increase in size and maturity. Structural elements for the continued survival of this species in the locality should be sufficient for potential occurrence from a rehabilitation age of 10 to 15 years (e.g. potential foraging opportunities).

Management measures for maintenance of suitable habitat

As the principle threat to this species comprises the loss, fragmentation and degradation of habitat, the main management measures include the staged clearing of existing habitat (to minimise the extent of habitat loss in the locality in any one year) and successful restoration of Habitat restoration and corridor enhancement zones.

Habitat restoration and corridor enhancement zones will be planted appropriately to provide a mosaic of habitats in the regional wildlife corridor. This would establish potential breeding territories and home ranges and provide areas of sufficient cover to escape predators such as foxes and cats. The wildlife corridor will be facilitated by the maintenance of a 500 m corridor between Boggabri Coal and Maules Creek Coal Mine.

Habitat features potentially used by this species, including hollow-bearing trees, fallen logs and bush rocks, will be retained within all offset managements zones throughout the BOAs. Following approved thinning or clearing, habitat resources will be relocated to BOAs to create additional nesting opportunities (refer Appendix E) for Spotted-tailed Quoll.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Spotted-tailed Quoll and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Addition and retention of habitat features, including hollow logs
- Weed and pest control, including the control of foxes and feral cats
- Grazing management
- Management of unauthorised access and disturbance.

F19.5 Management actions and performance criteria

Table F-27 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Spotted-tailed Quoll.

Table F-27 Management actions and performance criteria for Spotted-tailed Quoll

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of suitable habitat for the Spotted-tailed Quoll and prey species	All management zones[1]	Upgrade boundary fencing of all BOAs, as detatiled in Appendix E. Upgrade fencing around land designated as other lands for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other lands of agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

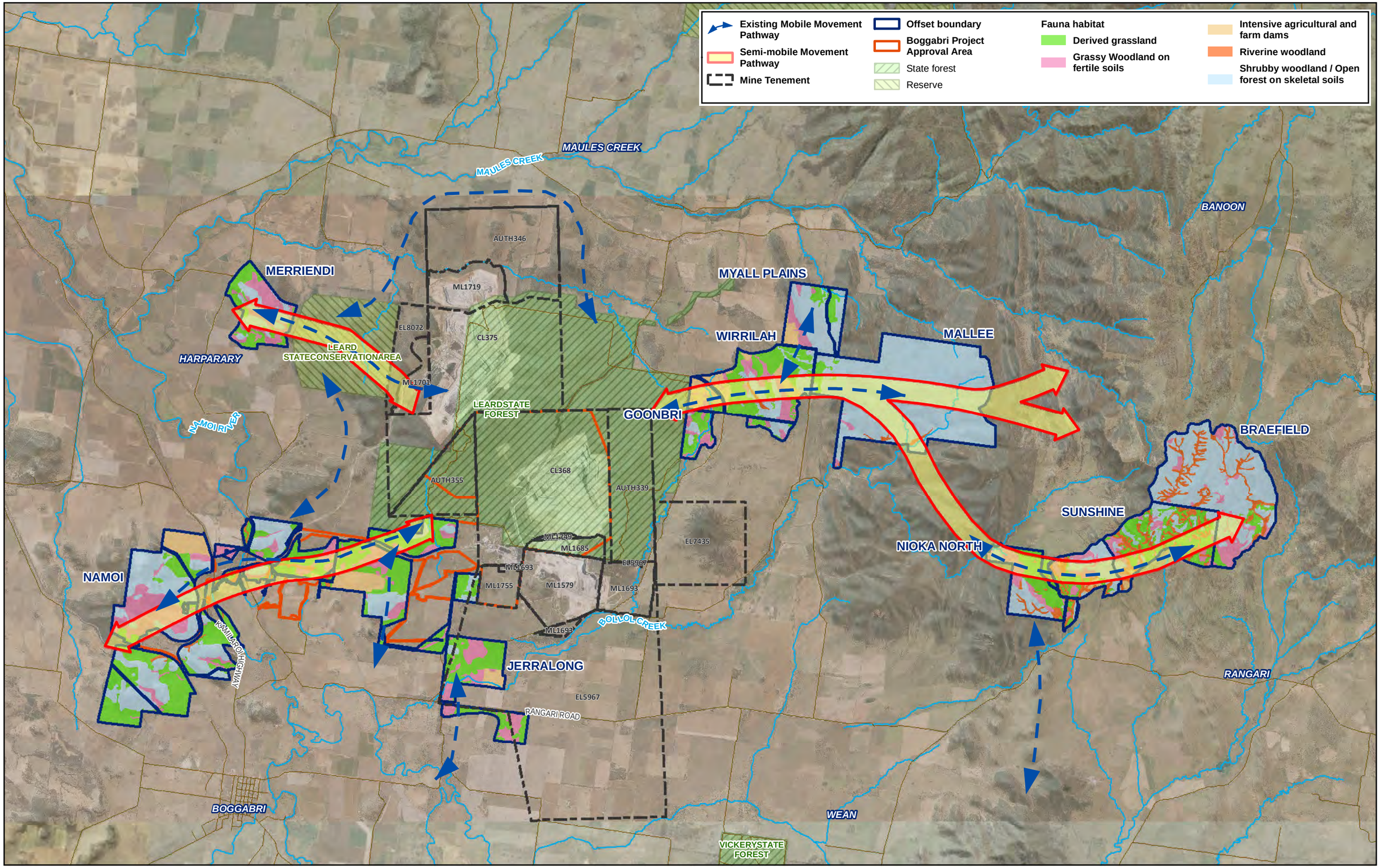
Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities.	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Habitat use	Habitat management	Annual biodiversity monitoring targeting threatened mammals and opportunistic sightings (refer Section 7.2 of the main BMP document).	Annual	Provision of annual biodiversity offset monitoring report detailing threatened mammal surveys and any threatened species recorded therein.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
		would commence at a density approximate to analogue sites.		
Canopy growth	Habitat restoration and corridor enhancement	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted species.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated Table F-7.
Inclusion of supplementary habitat features	Habitat restoration and corridor enhancement	Incorporation of ground timber in restoration areas	10 years 15 years	Salvaged resources are reused and relocated to BOA habitat restoration zones and are in structurally good condition. Provision of ground timber as per criteria detailed in Table F-7: • 50 % of ground timber to be incorporated from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate withi criteria detailed in Table F- 7. • 100 % of ground timber to be incorporated from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7.
Provision of supplementatry habitat for arboreal prey species	Habitat restoration and corridor enhancement	Incorporate nest boxes in restoration areas until natural generation of tree hollows predominates	10 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7.

Objective	Management zone	Management action	Timing	Performance criteria
			15 years	• Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).

Objective	Management zone	Management action	Timing	Performance criteria
Provision of suitable habitat for Spotted-tailed Quoll	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting threatened mammals and opportunistic sightings (refer Section 7.2 of the main BMP document).	>15 years	Provision of annual biodiversity offset monitoring report detailing targeted threatened mammal surveys and any threatened species recorded therein.
Fire control	All management zones[1]	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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MINE NAME.	2171706A_GIS_BMP016_A2
AUTHOR.	SuansriR
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APPENDIX F-14

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F20 Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is listed as Vulnerable under the BC Act.

Squirrel Gliders inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range. Suitable vegetation communities include at least one species of plant that flowers heavily in winter and one or more of the smooth-barked eucalypts (Department of Environment and Conservation 2005b).

Tree hollows greater than five centimetres diameter, in both living and dead trees as well as hollow stumps, are used as den sites for refuge and nesting (Gibbons & Lindenmayer 2000). Studies in Queensland showed that Squirrel Gliders used ironbark eucalypts and stags more than the hollows of smooth barked eucalypts and non-eucalypt tree species (Rowston 1998).

Squirrel Gliders use tree hollows for diurnal shelter either alone or in family groups of up to six individuals and offspring that occupy the same hollow simultaneously. The size and composition of groups of gliders occupying a particular hollow varies from day to day because gliders regularly swap den trees (van der Ree 2002). The nests are bowl-shaped and lined with leaves within tree hollows (Triggs 1996).

Squirrel Gliders are nocturnal and display seasonal trends in feeding behaviour that are in accordance with phenological patterns consists of trees and shrubs (Goldingay & Sharpe 1998). Their diet includes acacia gum, eucalypt sap, nectar, honeydew and manna, lichens with invertebrates and pollen providing protein (NSW National Parks and Wildlife Service 1999b).

Squirrel Gliders are agile climbers and can glide for more than 50 m in one movement. Nightly movements are estimated at between 300 m and 500 m. Home-ranges have been estimated at between 0.65 ha and 8.55 ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources, with more productive forests attributed to smaller home ranges (Quin 1995).

F20.1 Distribution of Squirrel Glider

The Squirrel Glider has not been recorded within the Project Boundary but it has been observed in four locations within the BOAs (refer Figure F-15, Table F-6).

F20.2 Threats

The following threats have been identified by the NSW OEH for the Squirrel Glider:

- Habitat loss and degradation.
- Fragmentation of habitat.
- Loss of hollow-bearing trees.
- Loss of understorey food resources.

- Inappropriate fire regimes.
- Reduction in food resources due to drought.
- Mortality due to entanglement on barbed wire.
- Occupation of hollows by exotic species.
- Mortality due to collision with vehicles.
- Predation by exotic predators.
- Changes in spatial and temporal distribution of habitat due to climate change.

F20.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Squirrel Glider:

- Protect large old trees and ensure their continued presence in the landscape by retaining medium sized trees, facilitating regeneration, and undertaking replanting. Large old trees within, adjacent to, or connecting vegetation remnants are particularly important.
- Protect, manage and restore habitat, prioritising sites within a region that may better function as drought refuges. Encourage the retention of a floristically and structurally diverse understorey, and raise public awareness of the damage caused to food resources by slashing/under scrubbing and over-grazing.
- Ensure populations remain connected by avoiding gaps greater than 50m between habitat patches and along linear remnants. Eliminate gaps through revegetation or the installation of crossing structures (e.g. rope bridges, glide poles), focusing on important movement pathways. Investigate the influence of habitat fragmentation on gene flow in different landscapes across the species' distribution.
- Identify sites where hollows are limiting and develop and implement strategies to increase hollow availability that have clear objectives and include monitoring, maintenance, and reporting requirements. Actions include nest box installation, the humane control of introduced species, and the protection of trees having the potential to develop hollows.
- Reduce direct mortality due to entanglement on barbed wire, vehicle collisions, and predation by cats and dogs. Encourage the use of plain wire fencing and the covering of barbed wire with polypipe. At sites with a high risk of vehicle collision, install crossing structures (e.g. rope bridges, glide poles) and/or reduce the canopy gap through revegetation.
- Undertake pest management of feral cats and dogs.

F20.4 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality. Habitat types of particular importance for this species include Riverine Woodland and Grassy Woodland on Fertile Soils, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones, as they contain large trees that generally provide an abundance of tree hollows of varying size classes. Furthermore, large areas of existing habitat (habitat management zones), such as that located in the Myall Plains, Wirrilah, Mallee, and the western portion of the Namoi BOAs, are likely to provide important habitat attributes for this species.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (refer Table F-8), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor (refer Table F-9). The Squirrel Glider is susceptible to the effects of habitat loss and degradation, particularly concerning the reduction of critical habitat resources (i.e. tree hollows). In the medium to long-term, 3,522.5ha of Habitat restoration and corridor enhancement will likely provide important foraging and potentially breeding in the locality. Moreover, the effective establishment of a regional wildlife corridor is envisaged to provide suitable habitat and movement pathways for all species in the locality. Therefore, a mosaic of habitats in the wildlife corridor, will necessarily provide microhabitat characteristics for this species and potentially provide movement pathways, effective home ranges and importantly, breeding habitat.

Management measures for maintenance of suitable habitat

A primary threat to the Squirrel Glider is the loss, fragmentation and degradation of habitat. Therefore, the most important management measure in the short-term is the protection of existing habitat (habitat management zones) in BOAs. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing any displaced individuals to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

In the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the restoration of the regional wildlife corridor will likely form important breeding and foraging habitat for this species in the locality. As this species is reliant on critically limiting resources (i.e. tree hollows), which will not naturally occur in areas of restoration (Habitat restoration and corridor enhancement zones) for a period greater than 50 years, and more likely greater than 100 years, restoration areas will need to be supplemented with appropriately sized nest boxes that may offer potential breeding habitat in the short to medium-term.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following

management measures address known threats to the Squirrel Glider and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Retention and addition of habitat features, including natural hollows and nest boxes
- Management of unauthorised access and disturbance.

F20.5 Management actions and performance criteria

Table F-28 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Squirrel Glider.

Table F-28 Management actions and performance criteria for Squirrel Glider

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and hollow-bearing trees	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment.

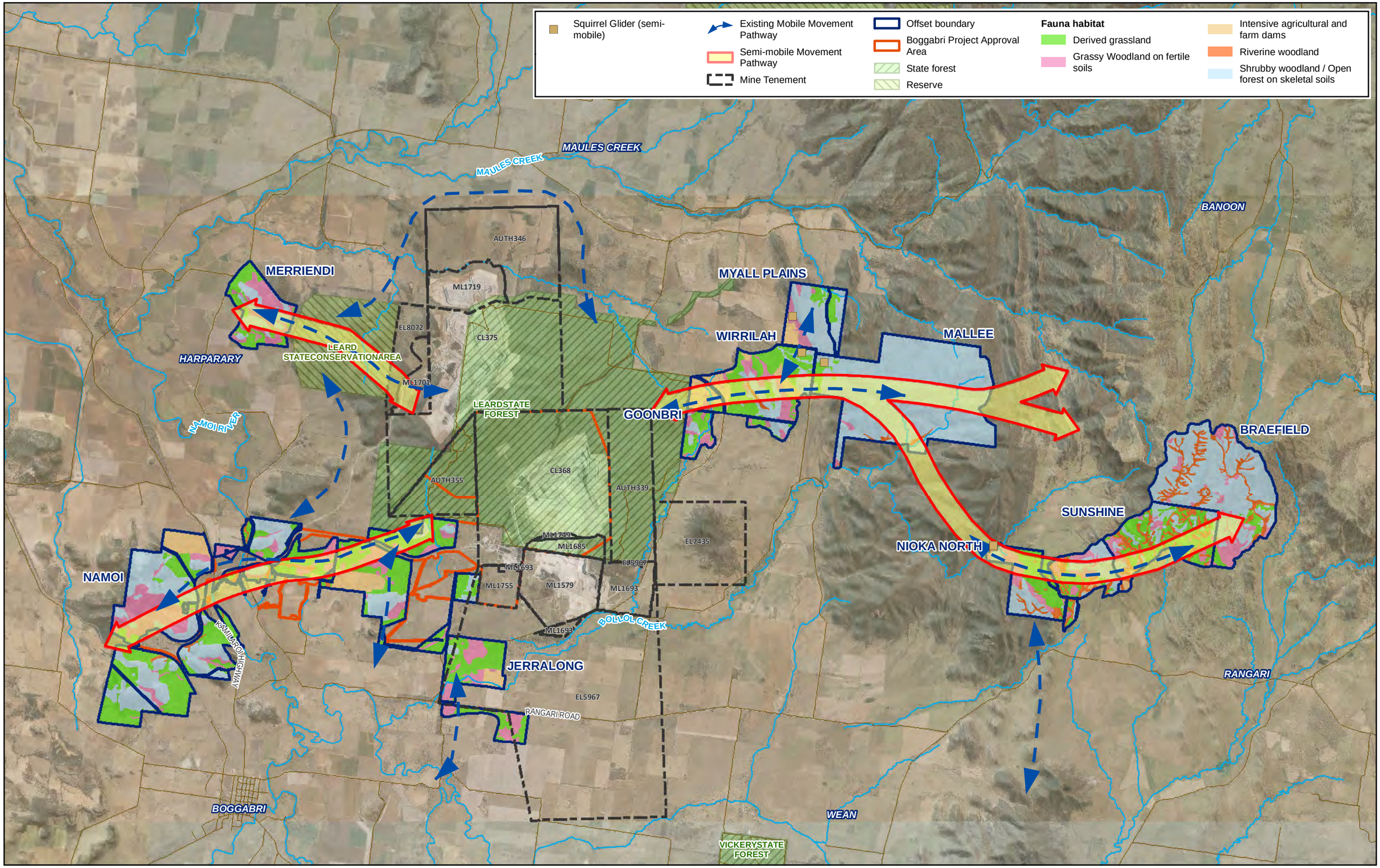
Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Habitat use	All management zones[1]	Annual biodiversity monitoring targeting threatened mammals and opportunistic sightings (refer Section 7.2 of the main BMP document).	Annual	Provision of annual biodiversity offset monitoring report detailing threatened mammal surveys and any threatened species recorded therein.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
		canopy species would commence at a density approximate to analogue sites.		
Canopy growth	Habitat restoration and corridor enhancement	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species.	5 year 10 year 15 year	Evidence of canopy growth in restoration area compared to baseline assessment and milestones nominated in Table F-7.
Provision of supplementatry habitat features suitable for shelter or breeding.	Habitat restoration and corridor enhancement	Incorporate nest boxes in restoration areas until natural generation of tree hollows predominates	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a rehabilitation age 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. • Incorporate 100% of nest boxes (remaining 50%) from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are

Objective	Management zone	Management action	Timing	Performance criteria
				no longer in structurally good condition they are replaced within a year of being identified.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Squirrel Glider	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting threatened mammals and opportunistic sightings (refer Section 7.2 of the main BMP document).	>15 years	Provision of annual biodiversity offset monitoring report detailing targeted threatened mammal surveys and any threatened species recorded therein.
Fire control	All management zones	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required.	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

Objective	Management zone	Management action	Timing	Performance criteria
		Periodic use of crash grazing to reduce (biomass) fuel loads		

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-15

SQUIRREL GLIDER

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F21 Koala (*Phascolarctos cinereus*)

The Koala is listed as Vulnerable under both the EPBC Act and BC Act.

The Koala occurs along the east coast of Australia and extends into Woodland, Mulga and River Red Gum forests west of the Great Dividing Range (Department of Environment and Climate Change 2008a). The range of the Koala covers all such suitable areas of NSW. The diet is generally restricted to Eucalypt leaves (Department of Environment and Climate Change 2008a), although on occasion, non-Eucalypt foliage is eaten. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. melliodora* (Yellow Box*), E. albens* (White Box), *E. blakelyi* (Blakely's Red Gum) and *E. microcarpa* (Western Grey Box) are some of the preferred and secondary food tree species for Koalas occurring on the Western Slopes and Plains (Department of Environment and Climate Change 2008b). Koalas use a wide variety of tree sizes, and do not preferentially use large or tall trees in NSW forests, although this has been listed as a habitat preference in areas where trees are generally small, stunted or nutrient deprived. Individual home ranges range from one to two ha in high quality habitat, to around 100 ha in more arid country where territories are usually discrete (Strahan and Van Dyck 2008).

Conservation status of the Koala in western NSW is variable (Department of Environment and Climate Change 2008b) . Most records for this species during detailed vertebrate fauna surveys for the Brigalow Belt South Western Regional Assessments (Pennay 2002) came from the Pilliga forests. Moreover, during recent surveys of the Pilliga forests, this species was found to be widespread and common in some areas with these forests reported as supporting a large Koala population (Department of Environment and Climate Change 2008b). Furthermore, the Koala population situated around Gunnedah has also been reported as increasing (Smith 1992).

F21.1 Distribution of Koala

Within the Project Boundary one dead Koala (cause of death uncertain) has been observed. As a result of this observation, a systematic grid based Koala habitat survey was undertaken throughout the Project Boundary and remaining Leard State Forest. One Koala was observed as a result of these surveys and five sites of 166 surveyed (3%) indicated Koala activity through the presence of Koala scats (refer Figure F-16).

The Koala has also been recorded in the Myall Plains and Namoi BOAs, with the remaining BOAs containing potential habitat for this species (refer Table F-6 and Figure F-16).

F21.2 Threats

The following threats have been identified by the NSW OEH for the Koala:

- Loss, modification and fragmentation of habitat
- Predation by feral and domestic dogs
- Intense fires that scorch or kill the tree canopy
- Road-kills
- Human-induced climate change, especially drought.

F21.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Koala:

- Identify and conserve habitat important for Koala conservation, particularly those areas containing Koala freed tree species.
- Undertake pest management for feral cats and dogs
- Liaise with relevant land and fire managers where known populations or habitat occurs, to ensure that prescribed burns that may affect riparian or floodplain habitat are cool burns and do not kill hollow-bearing trees or remove cohorts of smaller hollow-bearing species over large areas.
- Undertake revegetation and rehabilitate of identified potential Koala habitat areas utilising locally occurring Koala feed tree species.
- Erect suitable signage on roadsides known for Koala crossings to warn drivers.

F21.4 Maintenance of suitable habitat

Habitat management zone

The habitat management zone supports known and potential habitat for the Koala, including areas of Riverine Woodland that contain *E. camaldulensis*, which is listed as a primary food tree species for the western slopes and plains Koala management area (Department of Environment and Climate Change 2008a).

Furthermore, seven species listed as secondary food trees are present throughout the BOAs. Such species include *E. populnea*, *E. pilligaensis*, *E. melliodora*, *E. albens*, *E. dwyeri*, *E. dealbata* and *E. blakelyi*.

Approximately 7,120.0 ha of habitat is currently dedicated to habitat management within the BOAs, representing known and potential habitat for this species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality.

Habitat restoration and corridor enhancement zones

It is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement, which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor (refer Table F-9). In the medium to long-term, 3,522.5 ha of habitat restoration and corridor enhancement will likely provide important foraging and potentially breeding in the locality. Moreover, the effective establishment of a regional wildlife corridor is envisaged to provide suitable habitat and movement pathways for all species in the locality. Therefore, a mosaic of habitats in the wildlife corridor, will necessarily provide microhabitat characteristics for this species and potentially provide movement pathways and importantly, breeding habitat. The restoration of the four broad vegetation types within the BOAs will include the planting of both primary and secondary food tree species for the western slopes and plains Koala management area.

Restoration within the BOAs through active revegetation and passive regeneration of the existing soil seed bank is likely to provide limited habitat opportunities in the short to medium

term (e.g. 5-10 years), with increased usage thereafter as canopy values increase and planted trees develop trunks of sufficient size to maintain foraging habitats. Structural elements for the continued survival of this species in the locality should be sufficient for potential occurrence from a rehabilitation age of 10 to 15 years (e.g. potential foraging opportunities).

Management measures for maintenance of suitable habitat

A primary threat to the Koala is the loss, fragmentation and modification of habitat. Therefore, the most important management measure in the short-term is the protection of existing habitat (habitat management zones) in BOAs. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing any displaced individuals to relocate to other habitat areas in the immediate vicinity of the clearing footprint. The Clearing and Fauna Management Plan provides specific controls to be implemented in the event that this species is encountered during clearing operations and pre-clearing surveys (refer Appendix B).

In the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the restoration of the regional wildlife corridor will likely form important breeding and foraging habitat for this species in the locality.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to Koala populations and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Weed and pest control, including the control of wild dogs
- Grazing management
- Management of unauthorised access and disturbance.

F21.5 Management actions and performance criteria

Table F-29 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Koala.

Table F-29 Management actions and performance criteria for Koala

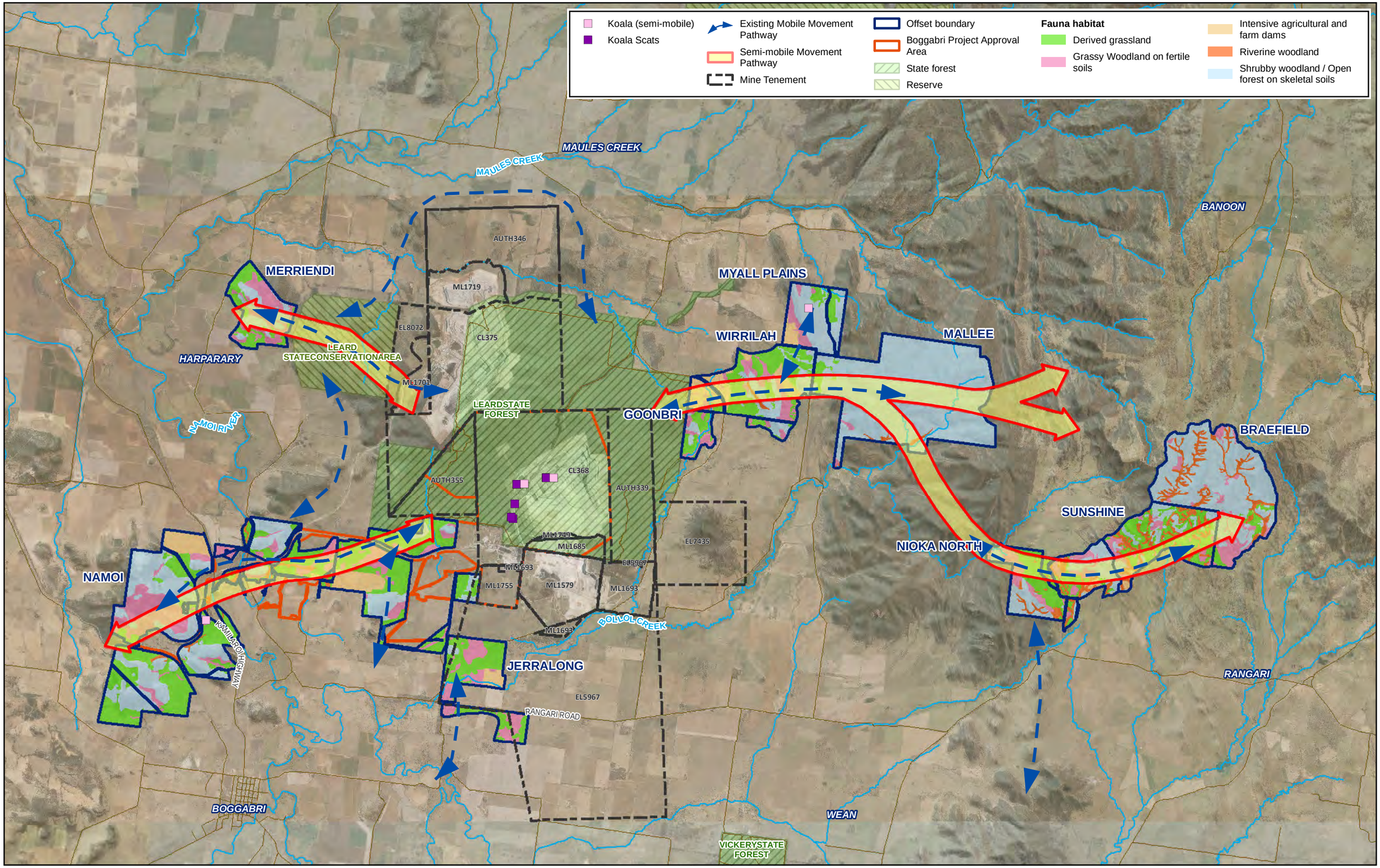
Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and hollow-bearing trees	All management zones[1]	Upgrade boundary fencing of all BOAs. Upgrade fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture.	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment

Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Habitat use	All management zones[1]	Annual biodiversity monitoring targeting threatened mammals and opportunistic sightings (refer Section 7.2 of the main BMP document).	Annual	Provision of annual biodiversity offset monitoring report detailing threatened mammal surveys and any threatened species recorded therein.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.

Objective	Management zone	Management action	Timing	Performance criteria
		species would commence at a density approximate to analogue sites.		
Canopy growth	Habitat restoration and corridor enhancement zones	Actively manage areas of restoration Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species.	5 year 10 year 15 year	Evidence of canopy growth in restoration zones compared to baseline assessment and milestones nominated in Table F-7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Koala	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.

Objective	Management zone	Management action	Timing	Performance criteria
Habitat use	Habitat restoration and corridor enhancement	Annual biodiversity monitoring targeting threatened mammals and opportunistic sightings (refer Section 7.2 of the main BMP document).	>20 years	Provision of annual biodiversity offset monitoring report detailing targeted threatened mammal surveys and any threatened species recorded therein.
Fire control	All management zones	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

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CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-16

KOALA

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F22 Pale-headed Snake (*Hoplocephalus bitorquatus*)

The Pale-headed Snake is listed as Vulnerable under the BC Act.

This species has a patchy distribution from north-east Queensland to north-east NSW. In NSW, it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. The species is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. It favours streamside areas, particularly in drier habitats. It is known to shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees (Broadhurst *et al.* 2008).

The snake eats a variety of vertebrates, particularly tree-dwelling species, including frogs, geckos, skinks and bats. Examination of museum specimens revealed that frogs were the most common prey item (77 percent of 26 prey items). Pale-headed Snakes hunt out in the open at night; however, during the day they may remain active within their shelter and ambush other creatures also taking refuge.

Examination of museum specimens showed that male Pale-headed Snakes appear to be sexually mature at a snout-vent length of 362 mm and females at 384 mm. The mean snout-vent length of gravid females was 512 mm. Mating behavior has been observed mostly in captive individuals. Behaviour interpreted as courtship took place in both spring (October) and autumn (April), and actual mating in spring (September), summer (February) and autumn (March, May). Courtship consisted of “frantic” tail wagging, with the male rubbing and twitching his body along the female’s body. Mating can occur at night and may last for several hours - one mating went from late at night until the following morning.

In the wild, females with very large follicles have been found in mid-spring (October) and gravid females have been found in early summer (January). The species is live-bearing, and give birth to between 2 and 11 young measuring around 26-27 cm long. In captivity, females appear to breed only every second year, even with regular feeding, so it is reasonable to assume that wild individuals do not reproduce annually (Matthei 1995).

F22.1 Distribution of Pale-headed Snake

The Pale-headed Snake has been recorded within the Project Boundary and is predicted to occur in each BOA, based on the presence of potential habitat (refer Table F-6 and Figure F-17).

F22.2 Threats

The following threats have been identified by the NSW OEH for the Pale-headed Snake:

- Clearing and fragmentation of habitat.
- Forestry practices which result in loss of old or dead trees.
- Too frequent burning for fuel reduction or grazing management which destroys old and dead trees and removes understorey vegetation.

- Illegal collection of snakes from the wild.
- Disturbance to riparian habitat from the installation and maintenance of easements.

F22.3 Recovery actions

The following applicable recovery actions have been identified by the NSW OEH for the Pale-headed Snake:

- Promote the maintenance and restoration of red gum/coolabah/black box woodlands in riparian zones and adjacent floodplains, particularly where hollows in living trees are abundant.
- Undertake plantings of suitable hollow-bearing trees (e.g. red gum, coolabah, black box) in riparian and floodplain areas where habitat has been lost or fragmented. Target planting to increase connectivity and buffer areas of existing old-growth woodland habitat.
- Erect suitably designed nest-boxes (microbat/glider style) in locations lacking tree hollows (e.g. young stands), and in areas in or close to known riparian habitat, to provide shelter for the species. Ensure that nest boxes are monitored regularly to evaluate their uptake and effectiveness.
- Liaise with relevant land and fire managers where known populations or habitat occurs, to ensure that prescribed burns that may affect riparian or floodplain habitat are cool burns and do not kill hollow-bearing trees or remove cohorts of smaller hollow-bearing species over large areas.

F22.4 Maintenance of suitable habitat

Habitat management zone

Approximately 7,120.0 ha of habitat are currently dedicated to habitat management within the BOAs, representing known and potential habitat for these species (refer Table F-9). Such areas likely represent important foraging and breeding habitat in the locality. Habitat types of particular importance for this species include Riverine Woodland and Grassy Woodland on Fertile Soils, which approximate 596.3 ha and 1,676.1 ha respectively in habitat management zones, as they contain large trees that generally provide an abundance of tree hollows of varying size classes. Furthermore, large areas of existing habitat (habitat management zones), such as that located in the Myall Plains, Wirrilah, Mallee, and the western portion of the Namoi BOAs, are likely to provide important habitat attributes for this species.

Habitat restoration and corridor enhancement zones

In the medium to long-term, it is estimated that an additional 3,522.5 ha are dedicated to habitat restoration and corridor enhancement within the BOAs (Table F-8), which will supplement existing areas of habitat management and effectively contribute to the viability of a regional wildlife corridor.

Restoration within the BOAs through active revegetation and passive regeneration of the existing soil seed bank is likely to provide limited habitat opportunities until the establishment of appropriate habitat resources. Structural elements for the continued

survival of this species in the locality should be sufficient for potential occurrence from a rehabilitation age of 20 years (e.g. potential foraging opportunities).

Management measures for maintenance of suitable habitat

A primary threat to the Pale-headed Snake is the clearing and fragmentation of habitat. Therefore, the most important management measure in the short-term is the protection of existing habitat (habitat management zones) in BOAs. Furthermore, the staged clearing of important habitat in the Project Boundary and implementation of the Clearing and Fauna Management Procedure (Appendix B) will help ameliorate the effects of habitat destruction, by potentially allowing any displaced individuals to relocate to other habitat areas in the immediate vicinity of the clearing footprint.

In the long-term, an important management measure for the maintenance of suitable habitat includes the restoration of a regional wildlife corridor effectively connecting larger areas of remnant woodland/ forest to the west of the Namoi River to the Nandewar Range in the east. It is envisaged that the restoration of the regional wildlife corridor will likely form important breeding and foraging habitat for this species in the locality.

Measures developed for the management of all native fauna and habitats in each BOA are detailed in specific management plans provided in Appendix E. The following management measures address known threats to the Pale-headed Snake and will be implemented within each BOA:

- Active and passive revegetation
- Selective thinning
- Retention and addition of habitat features, including natural hollows and nest boxes
- Grazing management
- Management of unauthorised access and disturbance.

F22.5 Management actions and performance criteria

Table F-30 outlines performance criteria associated with specific management actions for the long-term maintenance of viable stands of suitable habitat for the Pale-headed Snake.

Table F-30 Management actions and performance criteria for Pale-headed Snake

Objective	Management zone	Management action	Timing	Performance criteria
Short-term				
Protection of existing habitat and hollow-bearing trees	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other land for agriculture. Incorporate appropriate signage on boundary fencing.	<5 years	All BOA boundary fences and fences for other lands for agriculture have been installed/upgraded with appropriate signage, gates and locks to protect existing vegetation, exclude unwanted livestock grazing and prevent unauthorised access by year five.
Grazing exclusion	All management zones[1]	Upgrade boundary fencing of all BOAs, as detailed in Appendix E. Upgrade fencing around land designated as other lands for agriculture	<5 years	Livestock are excluded from all management zones following planting events at each BOA. Note: conservational grazing may occur from time to time in accordance with Section 6.2 (of the main BMP document) as required. Temporary fences may be used during crash grazing events to prevent livestock from entering sensitive areas.
Staged clearing of existing habitat in the Project Boundary	–	Maximum annual clearing limit not to exceed the forecasted 12 months of mine production, in accordance with the Clearing and Fauna Management Procedure (Appendix B).	Annual	Annual clearing completion report to be completed by ecologist detailing pre-clearing surveys, tree clearing activities and fauna relocated, euthanised or taken for specialist treatment

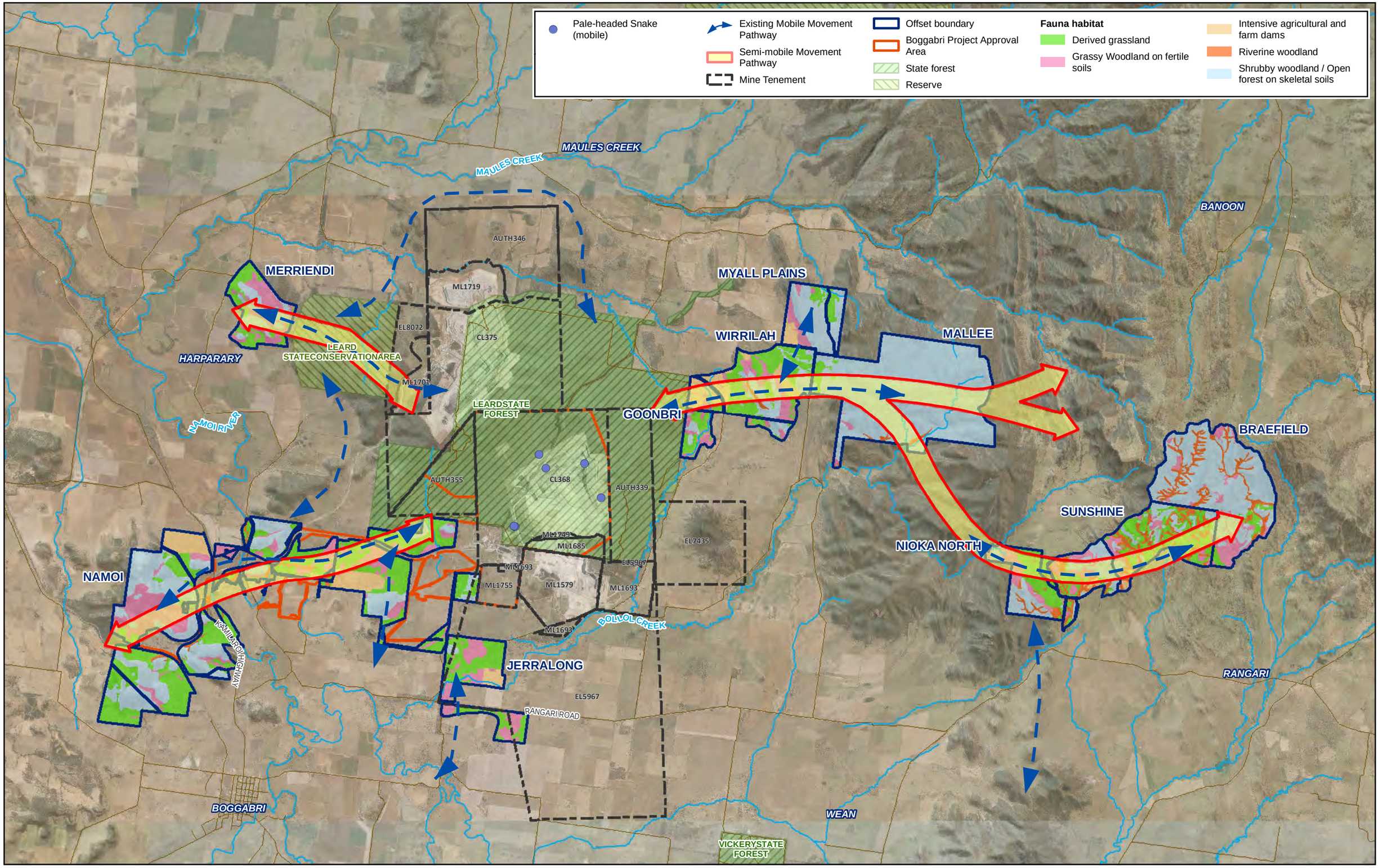
Objective	Management zone	Management action	Timing	Performance criteria
Clearing boundaries to be clearly delineated to minimise the potential for over clearing.	–	Clearing boundaries to be delineated by hi-visibility flagging tape. On-site personnel and sub-contractors will complete daily toolboxes acknowledging clearing limits, necessary procedures and activities	As necessary	All tree clearing events have been conducted in accordance with the Clearing and Fauna Management Procedure (Appendix B). All clearing boundaries to be delineated by hi-visibility flagging tape. No vegetation outside approved areas has been cleared and no soil stripping has occurred in these areas. On-site personnel and sub-contractors have completed daily toolbox to achknowledge clearing limits as well as necessary procedures and clearing limits and activities.
Medium-term				
Canopy recruitment	Habitat restoration	Actively manage areas of restoration. Inspections are to be completed on a five yearly basis to determine success of naturally regenerating canopy species. Further management actions may be required if regeneration significantly misses expected milestones. Alternatively, milestones may require adjustment to account for natural variation in succession. If regeneration is not evident in habitat restoration zones after 5 years, supplementary planting of canopy species would commence at a density approximate to analogue sites.	5 year 10 year 15 year	100% of BOA monitoring sites within the Habitat Restoration Zone show locally occurring canopy species recruiting.
Canopy growth	Habitat restoration and corridor enhancement	Actively manage areas of restoration.	5 year 10 year 15 year	Evidence of canopy regrowth as per milestones detailed in Table F-7.

Objective	Management zone	Management action	Timing	Performance criteria
		Inspections are to be completed on a five yearly basis to determine growth in naturally regenerating or planted canopy species.		
Provision of supplementary arboreal habitat.	Habitat restoration and corridor enhancement	Incorporate nest boxes in rehabilitation areas to account for time lag of natural generation of tree hollows	10 years 15 years	Installation of nest boxes as per criteria detailed in Table F-7: • 50% of nest boxes will be installed from a restoration age 10 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. • Incorporate 100% of nest boxes (remaining 50%) from a restoration age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7. 80% of nest boxes installed are being utilised or show signs of use by native species within BOAs. Utilisation of nest boxes by pest species such European Honey Bee, Common Myna, Common Starling and feral rodent species (Rattus and Mus spp.) should be recorded. Nest boxes structurally in good condition and functioning in the landscape. Where nest boxes are no longer in structurally good condition they are replaced within a year of being identified.
Inclusion of supplementary habitat features	Habitat restoration and corridor enhancement	Incorporation of ground timber in restoration areas		Salvaged resources are reused and relocated to BOA habitat restoration zones and are in structurally good condition.

Objective	Management zone	Management action	Timing	Performance criteria
				Provision of ground timber as per criteria detailed in Table F-7:
			10 years	• 50 % of ground timber to be incorporated from a rehabilitation age of 10 years, or when regenerating canopy species are commensurate withi criteria detailed in Table F-7.
			15 years	• 100 % of ground timber to be incorporated from a rehabilitation age of 15 years, or when regenerating canopy species are commensurate with criteria detailed in Table F- 7.
Long-term				
Maintenance, enhancement and restoration of fauna habitat	All management zones[1]	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers). Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark. Habitat Restoration Zones at each BOA show evidence of occupation or presence of at least 80% of native fauna species comparative to Leard State Forest analogue reference sites (as described in Section 7.1.1 of the main BMP document).
Provision of suitable habitat for Pale-headed Snake	Habitat restoration and corridor enhancement	Actively manage areas of restoration and annual biodiversity monitoring	20 years 30+ years	100% of BOA monitoring sites within Habitat Restoration Zones are within or above BBAM 2014 benchmark ranges for vegetation cover (i.e. overstorey, midstorey and groundcovers).

Objective	Management zone	Management action	Timing	Performance criteria
				Additionally, species richness at least 80% of native species richness BBAM 2014 benchmark.
Fire control	All management zones	Access tracks and fire breaks maintained in accordance with Section 6.2 of the main BMP document and in consultation with NSW Rural Fire Service, as required. Periodic use of crash grazing to reduce (biomass) fuel loads	As required	Schedule of maintenance for access tracks and fire breaks Documentation detailing any use of crash grazing (i.e. BOA, management zone, time period)

(1) Habitat management zone, habitat restoration zone, corridor enhancement zone and other land for agriculture zone.



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Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018); Copyright:© 2014 Esri

IDEMITSU BOGGABRI COAL

MINE NAME.	2171706A_GIS_BMP015_A2
AUTHOR.	SuansriR
CHECKED BY.	N.Cooper
DATE.	6/09/2018

APPENDIX F-17

PALE-HEADED SNAKE

TITLE.

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Appendix G

Agriculture suitability assessment

BOGGABRI COAL

MAY 2018

AGRICULTURAL IMPACT ASSESSMENT

REMOVAL OF AGRICULTURE ZONES AND CORRIDOR ZONES FROM AGRICULTURAL PRODUCTION IN THE ADDITIONAL BOGGABRI COAL BIODIVERSITY OFFSET AREAS

Question today
Imagine tomorrow
Create for the future

Agricultural Impact Assessment
Removal of Agriculture Zones and Corridor Zones from Agricultural Production in the Additional Boggabri Coal Biodiversity Offset Areas

Boggabri Coal

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REV	DATE	DETAILS
A	09/03/2018	Draft
B	25/05/2018	Final report

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Reviewed by:	Alex Cockerill	25/05/2018	
Approved by:	Rob Harrison	25/05/2018	

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1 BACKGROUND

This Agricultural Impact Assessment (AIA) has been developed for the Boggabri Coal Project (the Project) on behalf of Boggabri Coal Operations Pty Ltd (BCOPL), a wholly owned subsidiary of BCOPL Australia Resources Pty Limited (80%), Chugoku Electric Power Australia Resources Pty Ltd (10%) and NS Boggabri Pty Limited (10%).

This report addresses Schedule 3, Condition 48 of the Project's state conditions of approval PA 09_0182 (Project Approval) which requires Boggabri Coal to provide an agricultural suitability assessment of surplus land on the offset properties, for the proposed corridor enhancement zones, and maintain the agricultural productivity of the surplus areas. This AIA is required to form part of the Boggabri Coal Biodiversity Management Plan (BMP) (WSP, 2017).

A previous AIA was completed for the of the Agriculture Zones and Corridor Zones within the Boggabri Coal biodiversity offset areas (URS 2012). The former AIA covered the following offset areas:

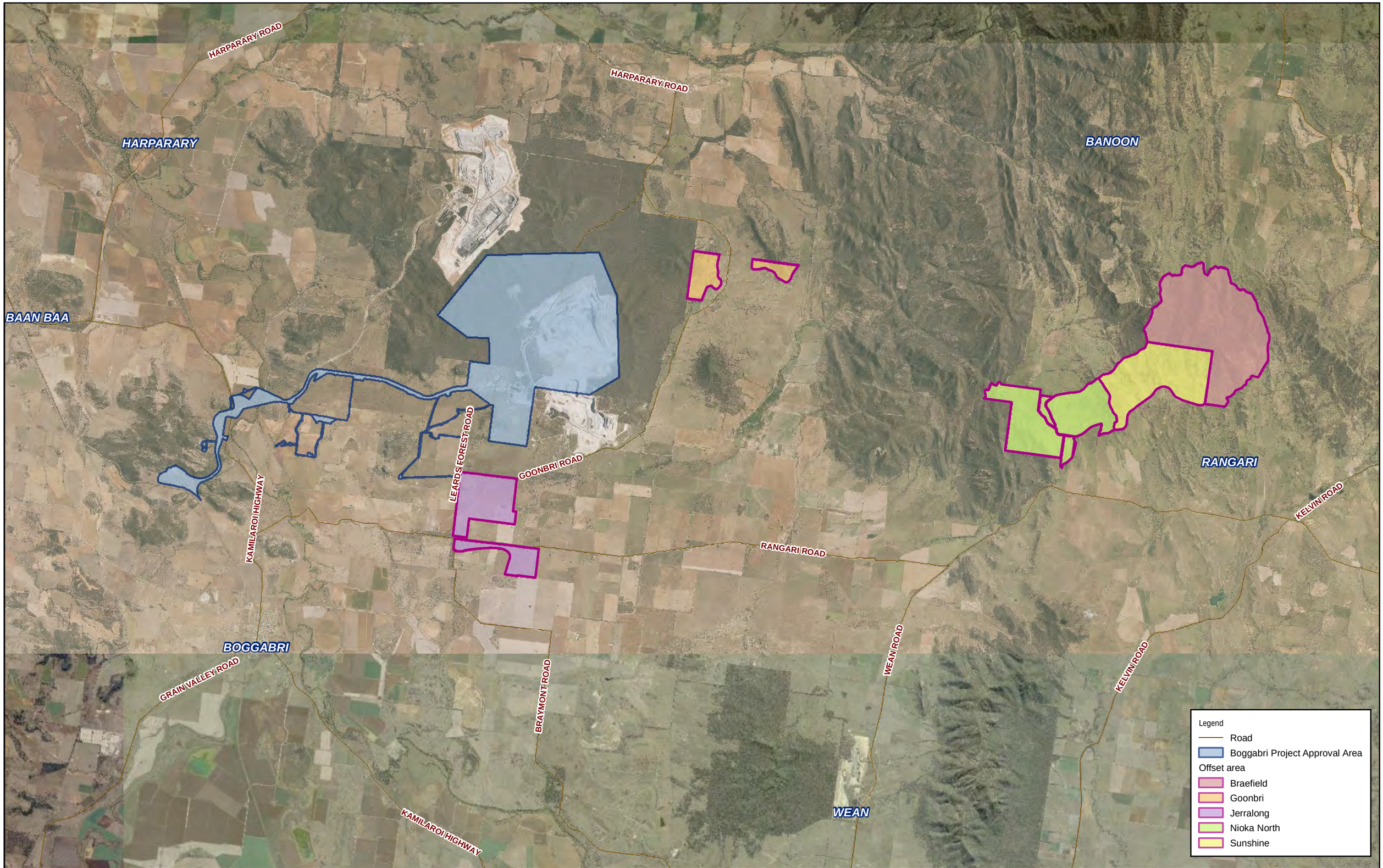
- Eastview
- Bellview
- Daisymede
- Heathcliffe
- Rocklea
- The Rock
- Travelling Stock Routes (TSR) 1, 2 and 3
- Wirrilah.

This subsequent AIA assesses the annual financial impact of removing the Agriculture Zones and Corridor Zones from agricultural production within five additional offset areas identified within the revised Boggabri Coal Biodiversity Offset Strategy (2017), including:

1. Braefield
2. Sunshine
3. Nioka North
4. Goonbri
5. Jerralong.

To maintain a level of consistency, this AIA has followed a similar approach and methodology to that applied to the former 2012 AIA (URS 2012), but has been specifically modified to suit the location, extent and purpose of this AIA.

The location of the additional offset areas subject of this assessment is presented on Figure 1.1.



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Scale 1:125,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

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FIGURE 1.1

TITLE. LOCATION OF OFFSET AREAS

2 ASSESSMENT METHODOLOGY

The methods presented below are specific to this AIA, but were developed in reference to those previously applied by URS in 2012. This approach ensures a level of consistency between the 2012 and 2018 assessments, as outlined in the following sections.

2.1 ASSESSMENT LIMITATIONS

The impact assessment was conducted during summer (late January – early February) when pasture productivity varies due to seasonal conditions, such as rainfall, relative humidity, heat and evapotranspiration rates. Therefore, the estimation of current and potential carrying capacity was reflective of the weather conditions leading up to the rapid field assessment and resulting level of pasture productivity.

The assessment also considered the level of livestock grazing currently occurring across each respective land holding being applied by lessees, which in most situations appeared to one of overstocking to maximise return. This in turn results in overgrazing and subsequent level of weed infestation, bare earth and reduced pasture diversity.

2.2 RAPID FIELD DATA CAPTURE

A rapid field assessment data sheet was developed for undertaking field surveys within the Agriculture Zones or Corridor Zones located within the offset areas. A desktop review of the Biodiversity Management Plan and Biodiversity Offset Strategy was conducted, which did not identify any additional data requirements, since the 2012 AIA was completed.

The rapid assessment method that has been applied in the field to the five additional offset areas in 2018, is similar to the methodology applied in 2012. However, some minor data inclusions or changes have been applied to ensure a more robust assessment. The attributes captured by the rapid field assessment data sheet are listed below in Table 2.1.

The rapid field assessment data sheet is designed to rapidly assess the current agricultural context and condition of survey locations within the agricultural land use sub-units associated with the overarching Agriculture Zone or Corridor Zone units, which have been mapped across each of the five recently committed offset areas. The rapid field assessments have been applied to one or more survey sites within each sub-unit.

Table 2.1 Attributes and field data captured by the rapid field assessment data sheet

Survey location
Site ID
Zone
Offset Area
Paddock ID
GPS
Photo #
Vegetation and land use
Native grassland (grazing)
Improved pasture (grazing)
Grassy woodland (grazing)
Open woodland (grazing)
Native regeneration (grazing)
Riparian woodland
Current cropping
Fallow
Post cropping (grazing)
Landform
River / creek channel
Alluvial plains / terraces
Clay plain
Hillside slopes
Ridgeline
Landscape features
Agricultural infrastructure
Disturbance history
Cropping
Fire
Over-grazing
Flood damage (erosion)
Heavy weed infestation
Current agricultural condition
% native grass cover
% exotic grass cover
% broad leaf weeds
% bare ground / rock
Total
Regenerating woody vegetation
Carrying capacity (DSE / ha)
Current
Potential
Additional notes:

2.3 SITE SELECTION

The combined areas allocated to the Agriculture Zone and Corridor Zone, were broken down into individual agricultural land use sub-units, and within each sub-unit one or more individual sites were subject to the rapid assessment method and field data recorded. The number of sites surveyed was reflective of the high level of biophysical variation associated with some of the sub-units assessed and their spatial distribution. For example, capturing the heterogeneity of vegetation types and condition between the river bank, a floodplain wetland, and a grassland site, all within a given grazing sub-unit.

The selection of sites for the rapid assessment was based on a visual appraisal of how representative that site was of the entire sub-unit. In cases where there are high levels of biophysical variation in a relatively small sub-unit then the number of sites selected and assessed increased to capture the variation. For example, in the Corridor Zone of Sunshine there is a variable undulating landscape of steep slopes, elevated ridgelines and gentle foot slopes within the one sub-unit, an additional survey site (C14a) was applied to capture this variation and inherent heterogeneity of the sub-unit. The number of survey sites located within the Agriculture and/or Corridor Zones for each offset area, is presented in Table 2.2.

Table 2.2 Number of survey sites located within the Agriculture and/or Corridor Zones for each offset area

OFFSET AREA	AREA (HA)	AGRICULTURE ZONE	CORRIDOR ZONE
Braefield	0.4	n/a	3
Sunshine	87.8	n/a	12
Nioka North	17.9	n/a	5
Goonbri	15.1	n/a	3
Jerralong	46.9	4	n/a
Totals	**215**	**4**	**23**

The Agriculture Zones and Corridor Zones for each respective offset area and locations of each survey site is presented on Figures 2.1–2.5.

2.4 GPS WAYPOINTS AND PHOTO RECORDS

A GPS waypoint was captured for each survey site and coordinates recorded on the rapid assessment data sheets. All waypoints were downloaded to a GPX file and presented on GIS maps (refer Figures 2.1–2.5). At least one photograph of each survey site was also captured and accompanies the rapid assessment data, along with the assigned photo numbers.

Systematically capturing the GPS location and taking photos of each survey site allows for repeat rapid assessments in the future, again and again if required. It also allows for the establishment of benchmark data for any repeat rapid assessments in the future, so that any changes identified and appropriately captured.

2.5 STANDARD ASSESSMENT FOR MEASURING AGRICULTURAL IMPACT

The Agriculture Zone and Corridor Zones support a range of land types that have been historically used for a variety of agricultural land uses and agro-economic purposes. In some instances, a specific land use may have occurred in the last two to three years, such as cropping. In other instances, there can be areas of abandoned cropping land use, which are yet to return to 100% native grass cover or pasture improved with exotic pasture species, or left fallow and comprised of woody weeds and/or a mix of native / exotic grasses. Such situations can be made even more complex where large areas of land are currently leased to graziers and either under winter or summer crops, or in the process of being converted back to perennial native and/or exotic pasture grasses.

To address this variability and maintain a reasonable level of informative assessment, the approach is to use a standard measurement of Dry Sheep Equivalent (DSE) per hectare, and to apply it to the varying agricultural land assessed. Due to, beef cattle production (i.e. cattle breeding) being the main agricultural enterprise occurring across the Agriculture Zones and Corridor Zones of the offset areas, the average DSE for a cow with calf at foot has been used. This standard approach enables a cumulative impact to be calculated from individual survey site data representative of the Agriculture Zones or Corridor Zones associated with each offset area.

2.6 IMPACT ANALYSIS PRINCIPLES

The standard principles for analysing the agricultural impact of removing agricultural land allocated to Agriculture Zones and Corridor Zones in the offset areas, from agricultural production, is presented in the following sections.

2.6.1 LIVESTOCK BASIC ECONOMIC UNITS

Even though the offset areas can support a mix of enterprises, cattle production, sheep production, fodder crops and/or grain crops, cattle production in the form of cow and calf at foot with calves sold as weaners at 8-10 months is the main agricultural enterprise currently occurring. Therefore, the basic economic unit for cattle production has been chosen for this assessment.

To avoid complicating the assessment and level of economic return from a cow and calf unit, the NSW Department of Primary Industry (DPI) standard gross margin for inland weaners has been adopted and will be applied to this assessment, as presented in Appendix A. The DPI inland weaner gross margin specifies that the DSE per cow and calf at foot unit is 15.25. Therefore, a slightly conservative 15 DSE per hectare has been applied for this assessment.

The DPI gross margins for inland weaner production are as follows:

- Gross Margin / Cow with calf to weaner age production $703.61
- Gross Margin / DSE $47.29
- Gross Margin / Ha $189.14.

2.6.2 ASSESSING CURRENT AND POTENTIAL CARRYING CAPACITY

The field survey was conducted 30 January to 3 February 2018 by a Principal Agricultural Ecologist and Senior Ecologist. The primary objective for this assessment was to evaluate the current carrying capacity at the time of the field survey. Therefore, the current carrying capacity was calculated from data captured during the survey and is reflective of the prevailing weather conditions prior to and at the time of the survey.

There was 37 mm of rainfall recorded at Boggabri Coal Mine from 9 January to commencement of the field survey 29 January, with an additional 9.2 mm falling until survey completion 2 February (46.2 mm in total). Daily temperatures ranged from approximately 22°C to 34°C, with a daily average of approximately 28°C. The combination of rainfall and warm temperatures provided some fresh pasture growth during the survey, which would have continued to increase over the subsequent weeks. This assisted with the assessment of current carrying capacity.

To compare the current carrying capacity and potential carrying capacity of the sub-units within the Agriculture Zone and Corridor Zone of the offset areas, two sets of calculations of carrying capacity have been applied. The current carrying capacity calculations of the sub-units are representative of site conditions and field data captured at the time of the field survey. The potential carrying capacity of the same sub-units reflects what could be achieved through improved land management to enhance productivity.

It has been assumed that abandoned or degraded sites within the sub-units may be suitable for sub-tropical pasture improvement activities. Ultimately, sub-tropical pasture improvement would significantly increase its carrying capacity potential from its current condition.

2.6.3 ASSIGNING STANDARD DSE RATINGS TO CURRENT CROPPING LAND

Expressing land that is currently under fodder crops (e.g. Oats) as a DSE rating is based on the following assumptions:

- A greater than 90% seed strike rate and good rainfall and level of productivity.
- Grazing of fodder crops for 80 days at 2.4 head of yearling cattle per hectare (1/acre). There is no difference to this formula if the stocking rate is lowered but grazing days extended, or stocking rate increased and grazing days reduced.
- Each weaner is a steer being grazed to the yearling or two year old steer markets, with 10 DSEs been allowed for each animal to gain between 1.5–2.00 kg per day.

This is equivalent to 24 DSEs/ha/day for 80 days amounting to 1,920 DSEs per ha. Divide this by 365 to get the average per/ha/day of 5.26 DSE/ha, which can be converted to the cow and calf standard DSE of 15 per hectare, which has been applied to this assessment.

The only land assessed as being currently cropped was within the Agricultural Zone on Jerralong, as shown on Photo 2.1.

Photo 2.1 Cattle grazing fodder crop of Oats in Agricultural Zone on Jerralong

2.6.4 ASSIGNING DSE RATINGS TO FORMER CROPPING LAND

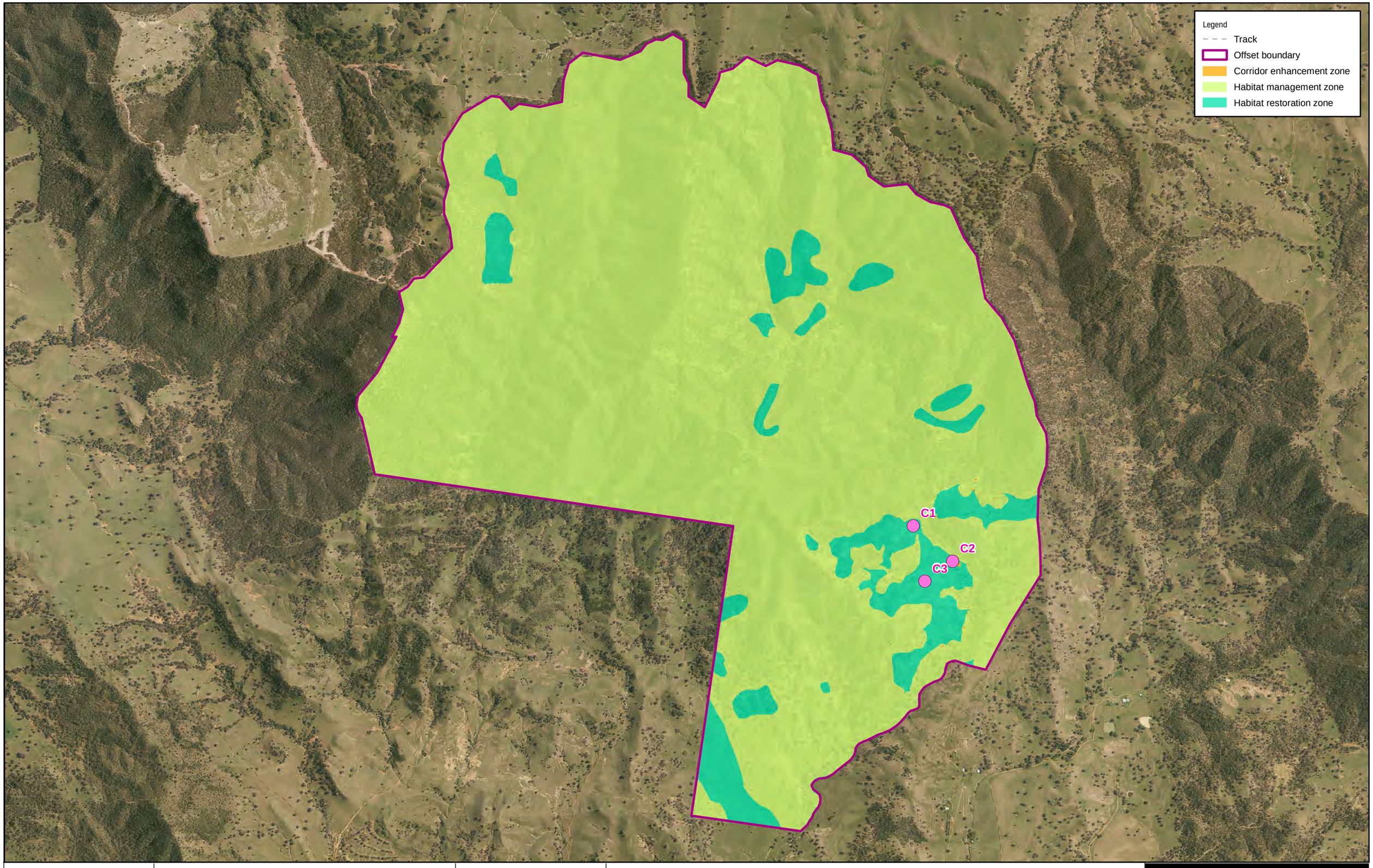
The Corridor Zones on Nioka North includes an area that has been previously cropped within the last 5–10 years and is now returning to native grassland. Two survey sites in this area (C16 and C19) indicates it is on its way to returning 100% native grass cover (80% for C16 and 85% for C19). Each of these respective sites was given a DSE rating on its present carrying capacity with consideration of soil type, landscape position and presence of weeds, which is reflective of this formerly cropped land returning to a native pasture grassland.

This previously cropped land is in the process of attaining the same DSE rating (4) as uncropped native pasture grasslands on the same soil type, which is reflected by the current DSE ratings 3.5 for C16 and 3.7 for C19. Therefore, in consideration of effective land management, such as weed control and pasture improvement, a potential DSE of 4 has been assigned. The rating of 4 considers any possible correction for lower production not visible because the land is currently not under fodder crop production (i.e. DSE of 5).

2.6.5 LIMITATIONS TO ASSESSING PAST AGRICULTURAL PERFORMANCE

The properties and variety of agricultural grazing land associated with each are essentially amalgamation of different properties of varying sizes and historical land uses, which have gradually been purchased and combined overtime, which is typical of agriculture in this part of New South Wales. The historical land uses and varying agricultural enterprises (i.e. sheep, cattle and/or cropping) of the once smaller properties has resulted in some variation to the overall resulting carrying capacity for each offset area.

The spread and number of sites surveyed has attempted to capture this variation to build an understanding of the whole, without needing to undertake more detailed assessments, such as agronomic soil and dry matter per hectare analysis. The assessment has therefore been undertaken to be informative, without being over detailed and complicated, and is considered fit for purpose.



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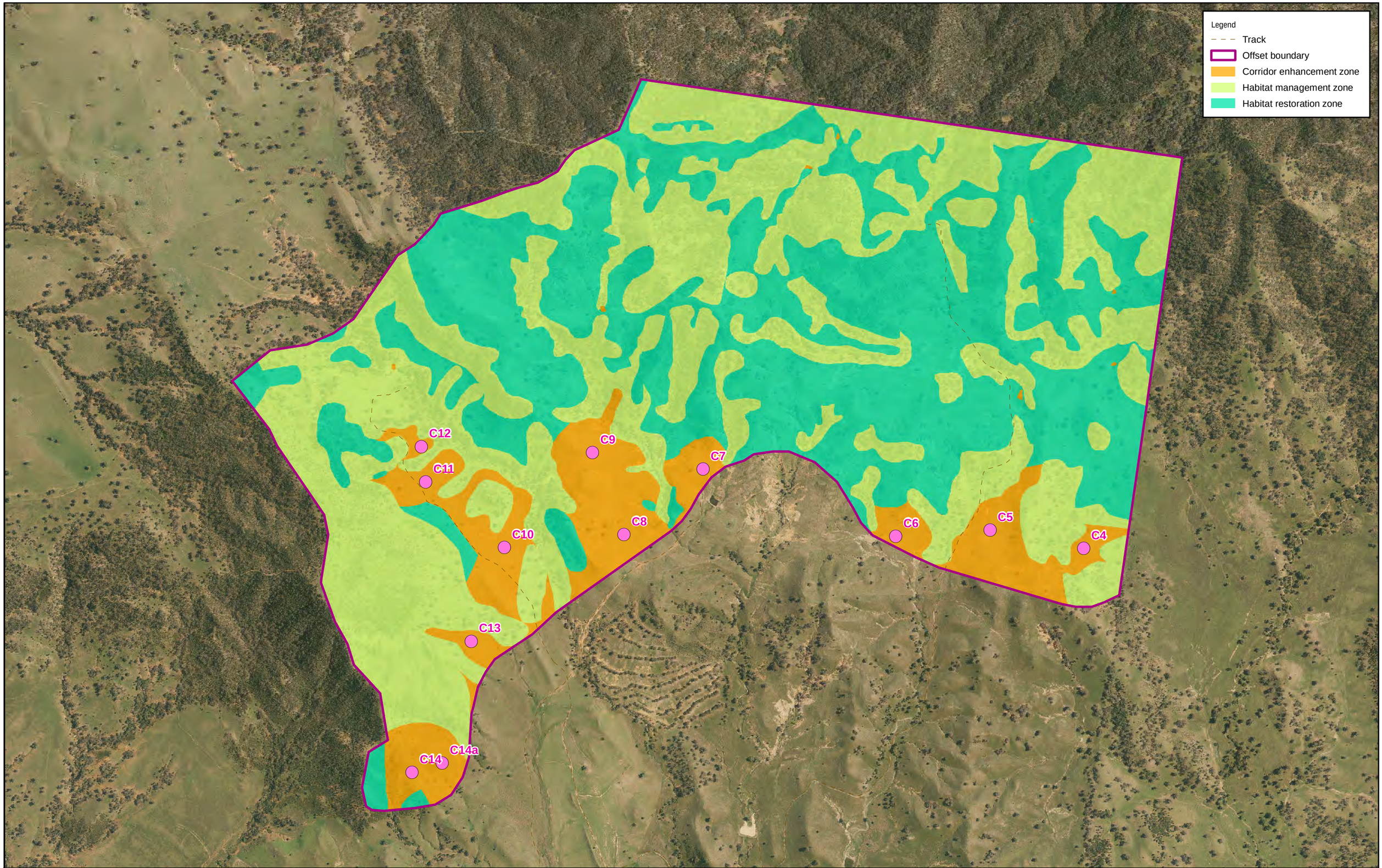
Scale correct when printed at A3 Landscape

Imagery:Atlass Imagery (2018);

MINE NAME.	PS107281_GIS_001_A1
AUTHOR.	SuansriR
APPROVED BY.	R.Harrison
DATE.	9/03/2018

FIGURE 2.1

TITLE. SURVEY EFFORT
BRAEFIELD BOA



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Imagery:Atlass Imagery (2018);

MINE NAME.	PS107281_GIS_001_A1
AUTHOR.	SuansriR
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DATE.	9/03/2018

FIGURE 2.2

TITLE. SURVEY EFFORT
SUNSHINE BOA

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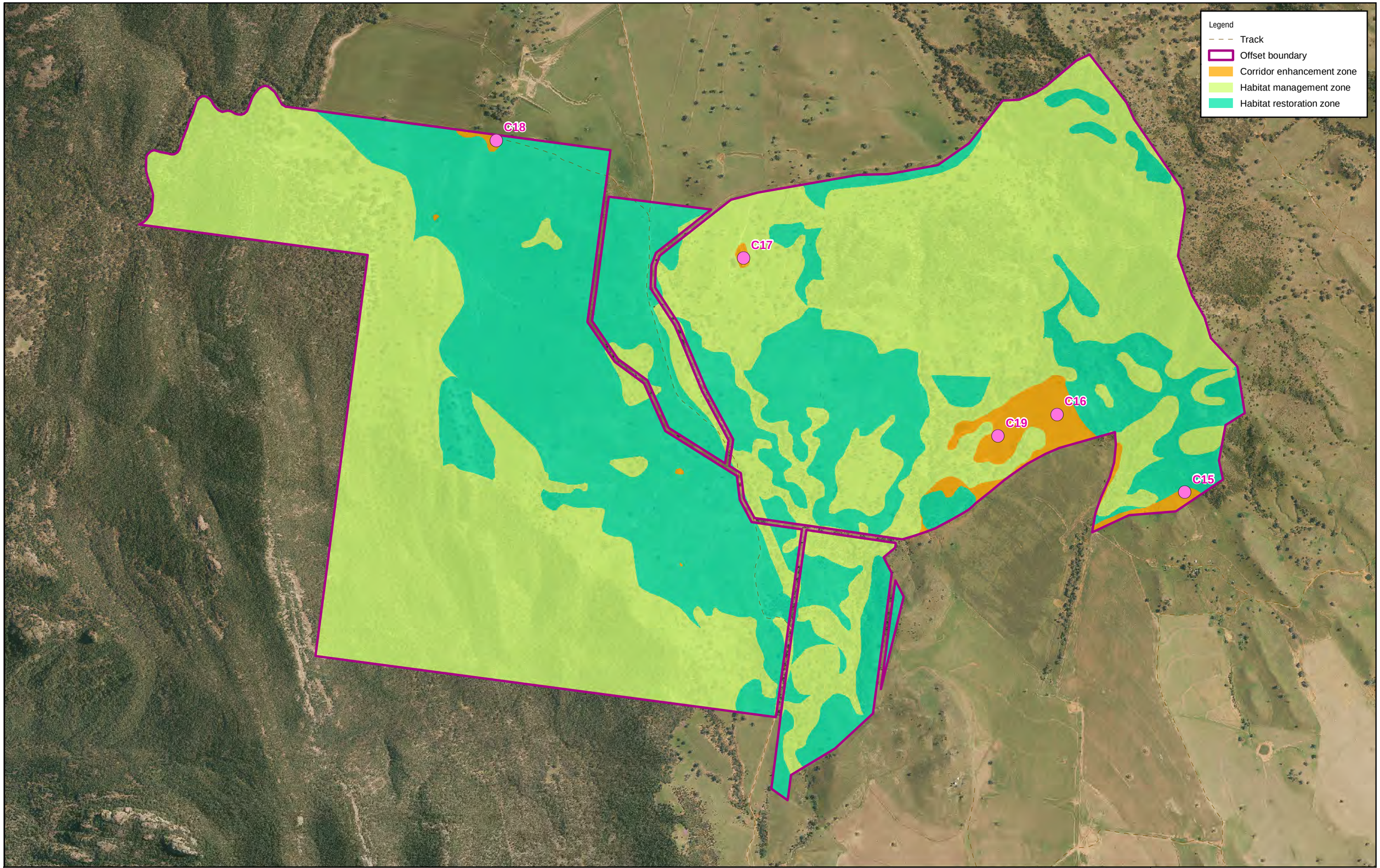

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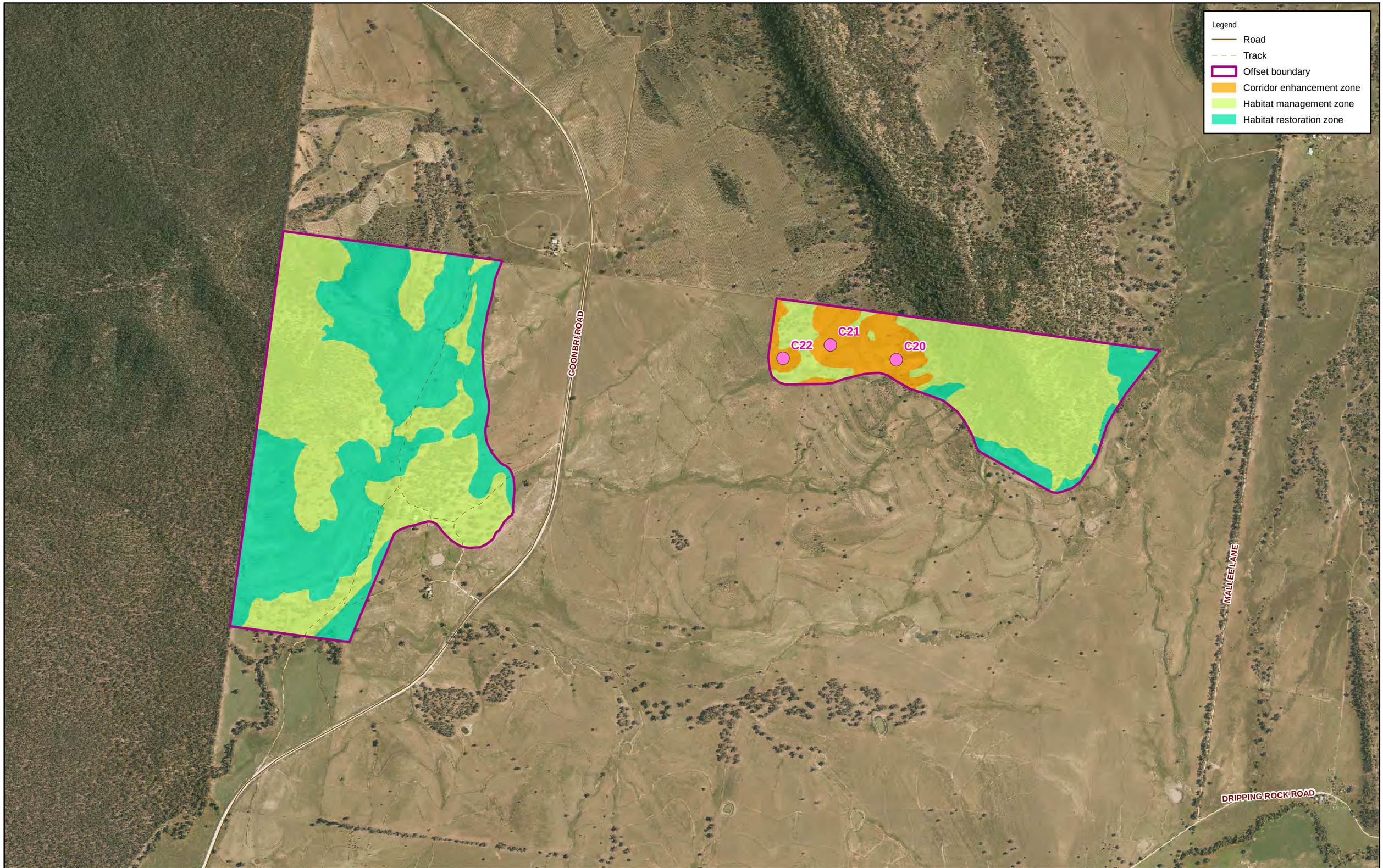
DATE.	9/03/2018

FIGURE 2.3

TITLE. SURVEY EFFORT
NIOKA NORTH BOA



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MINE NAME.	PS107281_GIS_001_A1
AUTHOR.	SuansriR
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DATE.	9/03/2018

FIGURE 2.4

TITLE. SURVEY EFFORT
GOONBRI BOA

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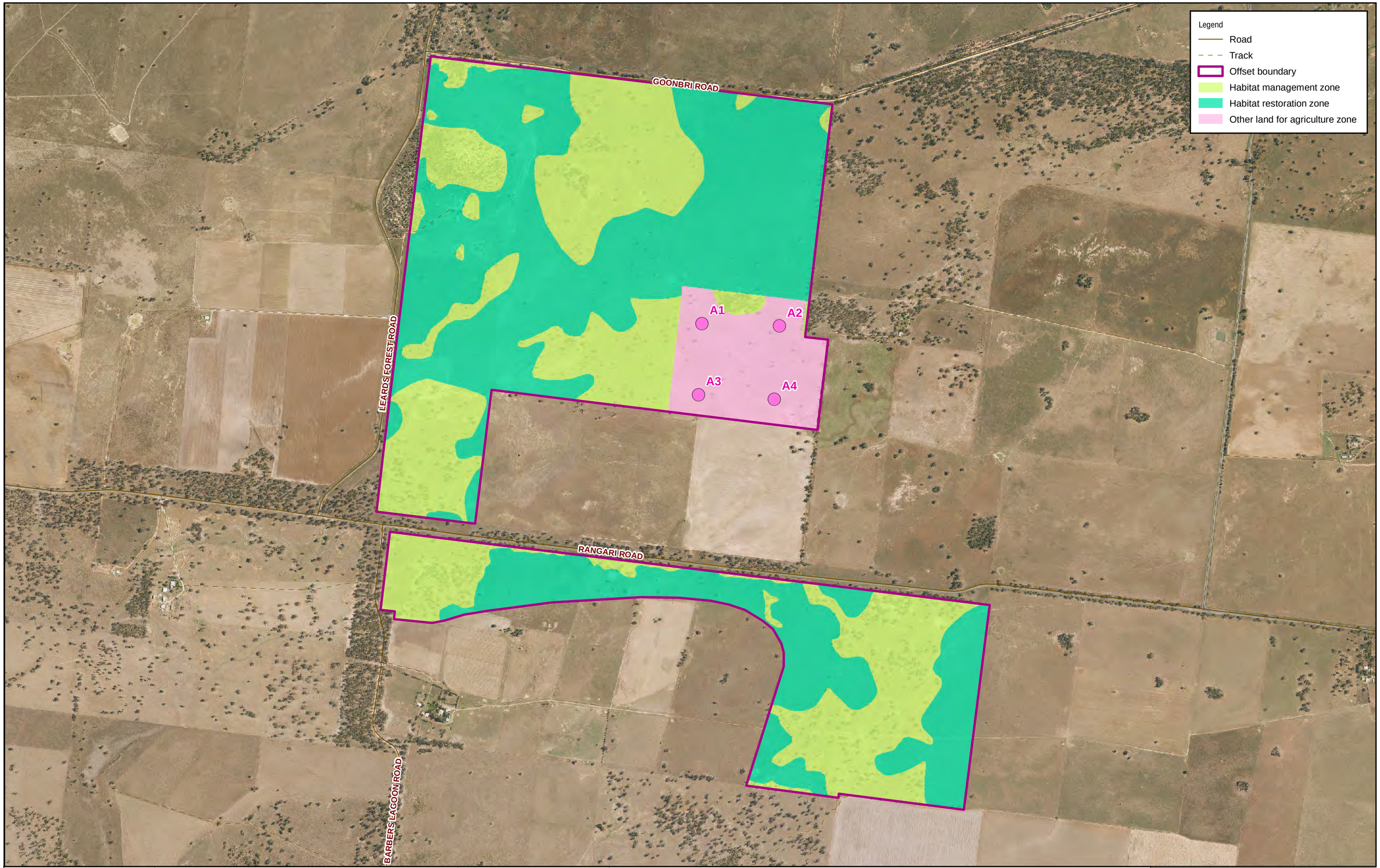

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DATE.	9/03/2018

FIGURE 2.5

TITLE. SURVEY EFFORT
JERRALONG BOA

3 RESULTS

3.1 ANALYSIS OF AGRICULTURE AND CORRIDOR ZONES

All of the rapid field assessment data collected from each survey site, is presented in Appendix B.

The results of the rapid field assessment for both the Agriculture Zones and/or Corridor Zones, along with the current and potential carrying capacity, for each of the five offset areas, are presented in Table 3.1 for the Agriculture Zones and Table 3.2 for the Corridor Zones.

Table 3.1 Current and potential DSEs based upon areas (ha) within the Agriculture Zones of each Offset Area

OFFSET AREA	ZONE AREA (HA)	SURVEY SITE ID	CURRENT DSE AND CARRYING CAPACITY			POTENTIAL DSE AND CARRYING CAPACITY		
			SURVEY SITE DSE	AVERAGE DSE	ZONE CARRYING CAPACITY (DSE)	SURVEY SITE DSE	AVERAGE DSE	ZONE CARRYING CAPACITY (DSE)
Jerralong	46.9	A1	3.4	**3.375**	**158.3**	5	**5**	**234.5**
		A2	3.2			5		
		A3	3.7			5		
		A4	3.2			5		

Table 3.2 Current and potential DSEs based upon areas (ha) within the Corridor Zones of each Offset Area

OFFSET AREA	ZONE AREA (HA)	SURVEY SITE ID	CURRENT DSE AND CARRYING CAPACITY			POTENTIAL DSE AND CARRYING CAPACITY		
			SURVEY SITE DSE	AVERAGE DSE	ZONE CARRYING CAPACITY (DSE)	SURVEY SITE DSE	AVERAGE DSE	ZONE CARRYING CAPACITY (DSE)
Braefield	0.4	C1	1	**0.5**	**0.2**	1.5	**0.8**	**0.3**
		C2	0.3			1		
		C3	0.2			1		
Sunshine	87.8	C4	3.2	**2.6**	**228.3**	4	**3.55**	**311.7**
		C5	3			4		
		C6	2.8			4		
		C7	1			2		
		C8	3			3.7		
		C9	3			3.7		
		C10	3			3.7		
		C11	2.7			3.7		
		C12	2.5			3.7		
		C13	2			3.7		
		C14	2.5			3		
		C14a	2.5			3.4		

OFFSET AREA	ZONE AREA (HA)	SURVEY SITE ID	CURRENT DSE AND CARRYING CAPACITY			POTENTIAL DSE AND CARRYING CAPACITY		
			SURVEY SITE DSE	AVERAGE DSE	ZONE CARRYING CAPACITY (DSE)	SURVEY SITE DSE	AVERAGE DSE	ZONE CARRYING CAPACITY (DSE)
Nioka North	17.9	C15	2.8	**3.26**	**58.4**	3.4	**3.78**	**67.7**
		C16	3.5			4		
		C17	2.8			3.5		
		C18	3.5			4		
		C19	3.7			4		
Goonbri	15.1	C20	2.7	**2.3**	**34.7**	3.4	**3.23**	**48.8**
		C21	2			2.8		
		C22	2.2			3.5		
Totals / averages	**168.1 (total)**			**2.407 (average)**	**404.6 (total)**		**3.272 (average)**	**550.0 (total)**

3.2 SUMMARY OF RESULTS

In reference to Table 3.1, for the total 46.9 ha of Agriculture Zones across the offset areas the following has been calculated:

- Current carrying capacity:
  - at an average DSE of 3.375 / ha, the total current carrying capacity for 46.9 ha is 158.3 DSE
  - based upon a cow and calf standard DSE of 15 per hectare, this equates to a potential cow and calf carrying capacity of **10.5 (11 rounded)** cows with calves to weaner age for the entire 46.9 ha of Agriculture Zones.
- Potential carrying capacity:
  - at an average DSE of 5 / ha, the total potential carrying capacity for 46.9 ha is 234.5 DSE
  - based upon a cow and calf standard DSE of 15 per hectare, this equates to a potential cow and calf carrying capacity of **15.6 (16 rounded)** cows with calves to weaner age for the entire 46.9 ha of Agriculture Zones.

In reference to Table 3.2, for the total 168.1 ha of Corridor Zones across the offset areas the following has been calculated:

- Current carrying capacity:
  - at an average DSE of 2.407 / ha, the total current carrying capacity for 168.1 ha is 404.6 DSE
  - based upon a cow and calf standard DSE of 15 per hectare, this equates to a potential cow and calf carrying capacity of **26.97 (27 rounded)** cows with calves to weaner age for the entire 168.1 ha of Corridor Zones.
- Potential carrying capacity:
  - at an average DSE of 3.272 / ha, the total potential carrying capacity for 168.1 ha is 550 DSE
  - based upon a cow and calf standard DSE of 15 per hectare, this equates to a potential cow and calf carrying capacity of **36.7 (37 rounded)** cows with calves to weaner age for the entire 168.1 ha of Corridor Zones.

Table 3.3 provides a summary of results for the Agriculture Zones and Corridor Zones.

Table 3.3 Summary of results for both Agriculture and Corridor Zones

ZONE	TOTAL AREA	CURRENT PRODUCTION CAPACITY	POTENTIAL PRODUCTION CAPACITY
Agriculture	46.9	DSE of 3.375 is 11 cows with calves	DSE of 5 is 16 cows with calves
Corridor	168.1	DSE of 2.407 is 27 cows with calves	DSE of 3.272 is 37 cows with calves
Total per annum combined	**215**	**38 cows with calves**	**53 cows with calves**

Table 3.4 presents the estimated DPI gross margins per annum for current and potential cows with calves to weaner age enterprise production, at $703.61 / unit, in the Agriculture Zones and Corridor Zones.

Table 3.4 Estimated DPI gross margins per annum for current and potential production in Agriculture Zones and Corridor Zones

ZONE	TOTAL AREA	CURRENT PRODUCTION CAPACITY	POTENTIAL PRODUCTION CAPACITY
Agriculture	46.9	11 cows with calves = $7,739.71	16 cows with calves = $11,257.76
Corridor	168.1	27 cows with calves $18,997.47	37 cows with calves = $26,033.57
Total per annum		**$26,737**	**$37,291**

As shown in the above, the total gross margin for removing a cow with calf to weaner age enterprise from agricultural production, using the standard measure of 15 DSE / unit, as based on current carrying capacity, is $26,737 / annum. On the other hand, based on the potential carrying capacity scenario, the same enterprise is estimated to be $37,291 / annum.

It is important to note, the DPI gross margin analysis (refer Appendix A), presents a set of assumptions that can vary based on seasonal weather condition and cattle live market prices. For example, high rainfall at the right time of year and more effective fodder production and yield, can generate increased average live weight for weaners going to market. This in turn influences the saleability and increased market prices for livestock in prime condition, due to being ready for slaughter and immediate processing, in place of being sold as stores that require backgrounding and growing on for later sale (i.e. further investment).

The variable costs used by DPI are a guideline and should be treated as such. Furthermore, they do not consider variability of inputs costs for production, which can change in response to seasonal weather conditions, such as purchasing feed during a dry winter. However, for the purpose of this assessment, DPI's published gross margin analysis is adequate and appropriate for the purpose of this assessment, and as such avoids going into the fine detail of obtaining information from lessees and/or neighbouring landholders, for which some information may not be available.

4 AGRICULTURAL VALUE

Due to the much smaller areas of land assessed within this assessment, a modified assessment of agricultural value has been applied compared to that of the previous 2012 assessment, while still maintaining a level of informative assessment.

Therefore, to identify the agricultural value and land suitability for this assessment, agricultural value ratings have been assigned to the Agriculture Zones and/or Corridor Zones within each offset area, in reference to the average DSE / ha value current and potential production capacity, for each offset area. This has been based on the following rating system:

- Low – average DSE / ha ≤2
- Medium – average DSE / ha >2 and ≤3.5
- High – average DSE / ha >3.5

Table 4.1 presents the current and potential agricultural value ratings for Agriculture Zones in the Jerralong offset area (no other offset areas apply), while Table 4.2 presents the agricultural value ratings for Corridor Zones in each offset area.

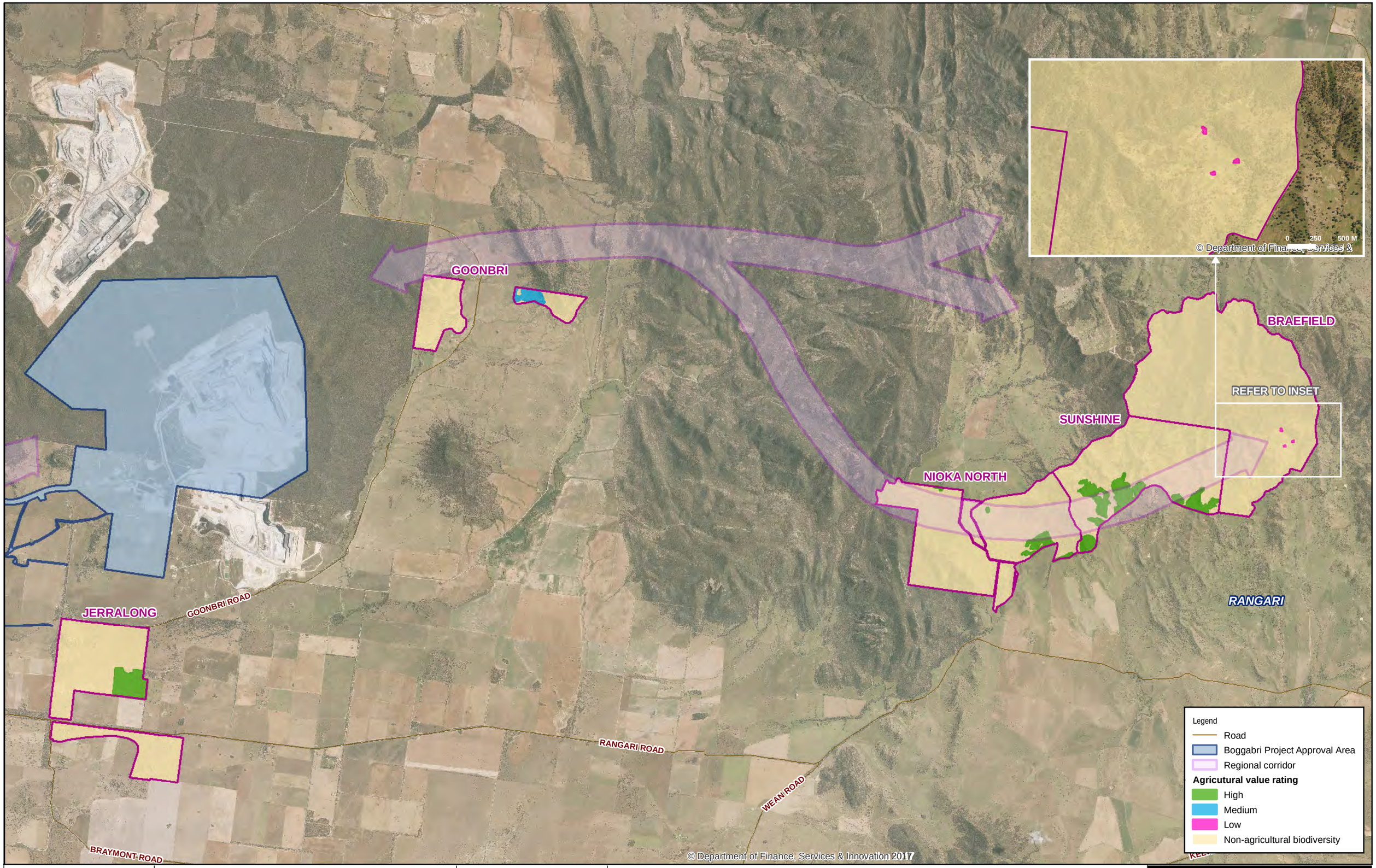
Table 4.1 Agricultural value ratings for the Agriculture Zones in each offset area

OFFSET AREA	SURVEY SITES	AREA (HA)	CURRENT		POTENTIAL	
			AVERAGE DSE / HA	RATING	AVERAGE DSE / HA	RATING
Jerralong	A1 – A4	46.9	3.375	**High**	5	**High**

Table 4.2 Agricultural value ratings for the Corridor Zones in each offset area

OFFSET AREA	SURVEY SITES	AREA (HA)	CURRENT		POTENTIAL	
			AVERAGE DSE / HA	RATING	AVERAGE DSE / HA	RATING
Braefield	C1 – C3	0.4	0.5	**Low**	0.8	**Low**
Sunshine	C4 – C14a	87.8	2.6	**Medium**	3.55	**High**
Nioka North	C15 – C19	17.9	3.26	**Medium**	3.78	**High**
Goonbri	C20 – C22	15.1	2.3	**Medium**	3.23	**Medium**

Figure 4.1 depicts the agricultural value ratings for the Agriculture Zones and Corridor Zones that have been assessed and evaluated within each offset area.



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Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery: Atlass Imagery (via BCOPL) (2017)

MINE NAME.	PS107281_GIS_003_A1
AUTHOR.	SuansriR
APPROVED BY.	R.Harrison
DATE.	9/03/2018

FIGURE 4.1

TITLE. THE AGRICULTURAL VALUE RATINGS FOR THE AGRICULTURE ZONES AND CORRIDOR ZONES

4.1 DISCUSSION

It is important to collectively evaluate the average DSE / ha, overall carrying capacity and ultimately the gross margins for each offset property, based on the potential production capacity of the land, instead of the current production capacity, which is based on current condition at the time of the rapid field assessment.

This collective evaluation approach has been applied to capture the land use variation that occurs across the offset areas. All of which are currently under lease arrangements with previous landholders or other graziers. Whereby, individual long-term objectives for triple bottom line sustainability may not be a priority or is driven by financial returns versus investment objectives for their respective agricultural enterprises. In other words, there is in some instances evidence of a reduced duty of care for managing the land sustainably, which is reflected in the agricultural ratings presented in Tables 4.1 and 4.2 above.

In this instance, it has been observed across some of the offset areas (e.g. Sunshine, Jerralong and Goonbri), evidence of substantial overgrazing, and subsequent weed infestation and degradation of agricultural productivity. This is a common theme, not only in New South Wales but also in Queensland, where agricultural land has been acquired by mining companies for offsets from graziers and where lease arrangements are in place (personal observations by author across numerous mine owned offset areas). Hence, the importance of understanding the potential of the land being assessed and what this means in terms of the annual financial impact of removing Agriculture and Corridor Zones from agricultural production, and ultimately the effect this has on the agricultural industry in New South Wales.

BCOPL, is considering maintaining agricultural land use production by means of utilising the surplus land currently under lease arrangements, which is not allocated to offset areas. This would involve establishing and managing an integrated cattle grazing, fodder production, cropping and feedlot operation.

In doing so, BCOPL could not only return this formerly productive land, which is gradually being degraded, back into a greater level of production and sustainability through capital investment and improved infrastructure. But could also establish a viable agricultural enterprise, which may potentially inject a greater level of agricultural income into the local and State agricultural industries. In doing so, make up for the current decline of productivity from this land, and may in fact make up for the loss of land, which is now under offsets.

5 CONCLUSION

All properties assessed by this AIA, have been placed under BCOPL's management and in part committed to biodiversity offsets. Except for Jerralong, all properties are currently considered to be of low to moderate agricultural value to the New South Wales agricultural industry, and as such the provision of biodiversity offsets, as assigned by the Biodiversity Offset Strategy, is of a minimal economic impact to the industry and local community.

This AIA has determined the impact of removing agricultural production from the Agriculture Zones and Corridor Zones of the offset areas, by means of using the DPI Northern Inland Weaner gross margin as the standard unit of measurement for assessing the level of agro-economic impact.

In summary it has determined that under current production capacity an estimated 38 cows with calves and estimated gross margin of $26,737 / annum will be removed from the local and State agricultural industry. While under a potential production capacity scenario an estimated 53 cows with calves and estimated gross margin of $37,291 / annum is hypothetically estimated to be removed from the local and State agricultural industry.

The loss of the above values from the agricultural industry has resulted from the allocation of agricultural land of varying levels of productivity to offsets for local biodiversity. This assessment provides important information to the State government for the purpose of understanding the cumulative agro-economic losses resulting from the allocation of agricultural land to offsets.

6 REFERENCE

PB (2012). *Boggabri Coal Biodiversity Offset Strategy*, Parsons Brinckerhoff, Newcastle.

WSP (2017). *Boggabri Coal Biodiversity Management Plan*, WSP, Newcastle.

URS (2012). *Agricultural Impact Assessment of Land Allocated to Agriculture and Corridor in the Boggabri Coal Biodiversity Offset Management Plan*. URS Canberra.

APPENDIX A

DPI GROSS MARGINS FOR INLAND WEANERS

NSW GOVERNMENT Primary Industries

BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: February 2017

Enterprise: **Inland store weaners**

Enterprise Unit: **100 cows**

Pasture: **Native pasture**

INCOME:			**Standard Budget**	**Your Budget**
42	steer weaners @	$1,079 /hd	$45,318	
21	heifer weaners @	$828 /hd	$17,388	
1	CFA Bull @	$1,554 /hd	$1,554	
6	CFA cows @	$1,116 /hd	$6,696	
0	Dry cows @	$1,116 /hd	$0	
13	Other culls @	$1,116 /hd	$14,508	
83				
	A. Total Income:		**$85,464**	

VARIABLE COSTS:						
Replacements	1	Bull @	$6,000	/hd	$6,000	
Livestock and vet costs: see section titled beef health costs for details.					$1,061	
Hay & Grain or silage. Low level supplementary feeding for 3 months					$2,250	
Drought feeding costs.					$0	
Pasture maintenence (372 Ha of native pasture)					$0	
Livestock selling cost (see assumptions on next page)					$5,792	
		B. Total Variable Costs:			**$15,103**	

GROSS MARGIN (A-B)	**$70,361**
GROSS MARGIN/COW	**$703.61**
GROSS MARGIN/DSE*	**$47.29**
GROSS MARGIN/HA	**$189.14**

Change in gross margin ($/cow) for change in price &/or the weight of sale stock

(Note: Table assumes that the price and weight of other stock changes in the same proportion as steers. As an example if steer sale price falls to 405c/kg and steer weight to 240 kg, gross margin would fall to $621 per cow. This assumes that price and weight of all other sale stock falls by the same percentage.

Liveweight (kg's) of Stock sold		**Steer sale price cents/kg live**				
		395	**405**	**415**	**425**	**435**
Steer wt.						
-40 kgs	**220**	542	559	576	593	610
-20 kgs	**240**	603	621	640	658	677
0	**260**	664	684	704	724	744
+20 kgs	**280**	724	746	767	789	810
+40 kgs	**300**	785	808	831	854	877

GM $ per Cow

An increase of 5% in weaning percentage increases gross margin per cow by $44.32

Assumptions **Inland store weaners**

Enterprise unit is 100 cows weighing on average 480 kg
Weaning rate: 84% - conception rate 90%

Sales

Steers sold at 9 months	260 kg	@415c/kg	live weight
Heifers sold at 9 months	230 kg	@360c/kg	live weight
21 heifers retained for replacement.			
Cull cows cast for age at 10 years	240 kg	@465c/kg	dressed weight
100% of preg tested empty cows culled	"	"	"
4% cows culled for other reasons	"	"	"
Bulls run at 3% & sold after 4 years use	420 kg	@370c/kg	dressed weight

Selling costs include: Commission 4%; yard dues $8.00/hd; MLA levy $5/hd; average freight cost to saleyards $12/hd; NLIS tags $3.60

Cows: age at first calf : 24 months

Mortality rate of adult stock: 2%

The average feed requirement of a cow + followers is rated at 2.21 LSU or 15.25 dse's. This is an average figure and will vary during the year.

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Age structure

Age	Number
2	21
3	18
4	15
5	13
6	11
7	9
8	7
9	6
Total Joined	**100**
10	6

Marketing Information:

Mainly sold to grass back-grounders for growing out.
Steers likely to end up in feedlots after further weight gain on grass.
Following sale, heifers either grown out to become breeders or fattened for the local trade market.

Production Information:

Mixed sex weaners sold from March to June from lighter country or at heavier stocking rates than for vealers. Common on unimproved areas with some supplementary feed in normal years.
This enterprise is the most drought susceptible.

APPENDIX B

RAPID ASSESSMENT FIELD DATA

B1 RAPID ASSESSMENT FIELD DATA

Survey location				
Site ID	A1	A2	A3	A4
Zone	Agriculture	Agriculture	Agriculture	Agriculture
Offset Area	Jerralong	Jerralong	Jerralong	Jerralong
Paddock ID	Jerry's crop	Jerry's crop	Jerry's crop	Jerry's crop
GPS	E: 225645	E: 226047	E: 225625	E: 226020
	N: 6603805	N: 6603792	N:6603435	N: 6603412
Photo #	1857-1860	1853-1856	1861-1865	1866-1871
Vegetation and land use				
Native grassland (grazing)				
Improved pasture (grazing)				
Grassy woodland (grazing)				
Open woodland (grazing)				
Native regeneration (grazing)				
Riparian woodland				
Current cropping	yes	yes	yes	yes
Fallow				
Post cropping (grazing)				
Landform				
River / creek channel				
Alluvial plains / terraces	yes	yes	yes	yes
Clay plain				
Hillside slopes				
Ridgeline				
Landscape features	scattered poplar box in cropland	scattered poplar box in cropland	scattered poplar box in cropland	scattered poplar box in cropland
Agricultural infrastructure				farm dam
Disturbance history				
Cropping	yes	yes	yes	yes
Fire				
Over-grazing				
Flood damage (erosion)				
Heavy weed infestation	yes	yes		
Current agricultural condition				
% native grass cover	0	0	10	1
% exotic grass cover	50	40	70	44
% broad leaf weeds	5	10	0	5
% bare ground / rock	45	50	20	50
Total	**100**	**100**	**100**	**100**
Regenerating woody vegetation				
Carrying capacity (DSE / ha)				
Current	**3.4**	**3.2**	**3.7**	**3.2**
Potential	**5**	**5**	**5**	**5**
Additional notes: All sites in paddock sown to exotic perrenial pasture grasses, some remaining oats and annual rye. Small amounts of regenerating native grasses.				

Photo B.1 A1 survey site in Agriculture Zone on Jerralong

Photo B.2 A2 survey site in Agriculture Zone on Jerralong

Photo B.3 A3 survey site in Agriculture Zone on Jerralong

Photo B.4 A4 survey site in Agriculture Zone on Jerralong

Survey location			
Site ID	C1	C2	C3
Zone	Corridor	Corridor	Corridor
Offset Area	Braefield	Braefield	Braefield
Paddock ID	Small dam	Gully dam	Gully dam 2
GPS	E: 253596	E: 253332	E: 253410
	N: 6609427	N: 6609664	N: 6609291
Photo #	1676-1682	1683-1696	1697-1709
Vegetation and land use			
Native grassland (grazing)	yes		yes
Improved pasture (grazing)			
Grassy woodland (grazing)			
Open woodland (grazing)			
Native regeneration (grazing)		yes	
Riparian woodland			
Current cropping			
Fallow			
Post cropping (grazing)			
Landform			
River / creek channel			
Alluvial plains / terraces			
Clay plain			
Hillside slopes	yes	yes	yes
Ridgeline			
Landscape features	adjacent to creekline, lower slopes small farm dam	on drainage line	on drainage line
Agricultural infrastructure	small farm dam, on access track, fences good condition	small farm dam, access track	small farm dam
Disturbance history			
Cropping			
Fire			
Over-grazing	yes		yes
Flood damage (erosion)	surface overflow	surface overflow and gully	gully
Heavy weed infestation			
Current agricultural condition			
% native grass cover	20	3	5
% exotic grass cover	0	5	3
% broad leaf weeds	10	2	2
% bare ground / rock	70	90	90
Total	**100**	**100**	**100**
Regenerating woody vegetation		yes	
Carrying capacity (DSE / ha)			
Current	**1**	**0.3**	**0.2**
Potential	**1.5**	**1**	**1**
Additional notes: Highly eroded, corridor zones associated with farm dam and immediate surrounds. Substaintial rehabilitation required to re-establish grazing.			

Photo B.5 C1 survey site in Corridor Zone on Braefield

Photo B.6 C2 survey site in Corridor Zone on Braefield

Photo B.7 C3 survey site in Corridor Zone on Braefield

Survey location			
Site ID	C4	C5	C6
Zone	Corridor	Corridor	Corridor
Offset Area	Sunshine	Sunshine	Sunshine
Paddock ID	Paddock of hills	Paddock of hills	Paddock of hills
GPS	E:251680	E:251264	E:250844
	N:6607925	N:6608005	N6607979
Photo #	1758 - 1762	1753 - 1757	1763 - 1768
Vegetation and land use			
Native grassland (grazing)	Yes	Yes	Yes
Improved pasture (grazing)			
Grassy woodland (grazing)			
Open woodland (grazing)			
Native regeneration (grazing)			
Riparian woodland			
Current cropping			
Fallow			
Post cropping (grazing)			
Landform			
River / creek channel			
Alluvial plains / terraces			
Clay plain			
Hillside slopes	Yes - Undulating low hills	Yes - Undulating low hills	Yes - Undulating low hills
Ridgeline			
Landscape features	Low udulating hills	Low undulating hills	Low undulating hills
Agricultural infrastructure			
Disturbance history			
Cropping			
Fire			
Over-grazing	Yes	Yes	Yes
Flood damage (erosion)			
Heavy weed infestation			
Current agricultural condition			
% native grass cover	78	75	60
% exotic grass cover	0	0	0
% broad leaf weeds	20	15	35
% bare ground / rock	2	10	5
Total	**100**	**100**	**100**
Regenerating woody vegetation			
Carrying capacity (DSE / ha)			
Current	**3.2**	**3**	**2.8**
Potential	**4**	**4**	**4**
Additional notes:			

Photo B.8 C4 survey site in Corridor Zone on Sunshine

Photo B.9 C5 survey site in Corridor Zone on Sunshine

Photo B.10 C6 survey site in Corridor Zone on Sunshine

Survey location			
Site ID	C7	C8	C9
Zone	Corridor	Corridor	Corridor
Offset Area	Sunshine	Sunshine	Sunshine
Paddock ID	Scrappy	Wide gully	Wide gully
GPS	E: 249986	E: 249633	E: 249494
	N: 6608277	N: 6607987	N: 6608350
Photo #	1830-1837	1846-1850	1838-1845
Vegetation and land use			
Native grassland (grazing)	yes	yes	yes
Improved pasture (grazing)			
Grassy woodland (grazing)			
Open woodland (grazing)			
Native regeneration (grazing)			
Riparian woodland			
Current cropping			
Fallow			
Post cropping (grazing)			
Landform			
River / creek channel			
Alluvial plains / terraces			
Clay plain			
Hillside slopes	yes	yes	yes
Ridgeline			
Landscape features	highly erodable exposed geology, numerous eroded gullies	undulating rises on lower slopes	undulating rises on lower slopes
Agricultural infrastructure	farm dam		
Disturbance history			
Cropping			
Fire			
Over-grazing	yes		yes
Flood damage (erosion)	yes gully and surface erosion		
Heavy weed infestation			
Current agricultural condition			
% native grass cover	15	82	70
% exotic grass cover	0	0	0
% broad leaf weeds	25	15	25
% bare ground / rock	60	3	5
Total	**100**	**100**	**100**
Regenerating woody vegetation	yes		
Carrying capacity (DSE / ha)			
Current	**1**	**3**	**3**
Potential	**2**	**3.7**	**3.7**
Additional notes: C7 - substantial erosion control, soil importation and soil stabilisation required to re-establish grazing pasture.			

Photo B.11 C7 survey site in Corridor Zone on Sunshine

Photo B.12 C8 survey site in Corridor Zone on Sunshine

Photo B.13 C9 survey site in Corridor Zone on Sunshine

Survey location				
Site ID	C13	C14	C14a	C15
Zone	Corridor	Corridor	Corridor	Corridor
Offset Area	Sunshine	Sunshine	Sunshine	Nioka North
Paddock ID	Hill toe	Big hill	Big hill	Rocky crop paddock
GPS	E: 248952	E: 248690	E: 248824	E: 248314
	N: 6607511	N: 6606927	N: 6606969	N: 6606718
Photo #	1804-1809	1791-1796	1797-1803	1745-1752
Vegetation and land use				
Native grassland (grazing)	yes			yes
Improved pasture (grazing)				
Grassy woodland (grazing)		yes		
Open woodland (grazing)				
Native regeneration (grazing)			yes	
Riparian woodland				
Current cropping				
Fallow				
Post cropping (grazing)				
Landform				
River / creek channel				
Alluvial plains / terraces				
Clay plain				
Hillside slopes	yes		yes	yes
Ridgeline		yes		
Landscape features	toe of hills, low undultaing ridgeline slopes	steep hills, rocky outcrops	midslope, steep, rock outcrops	small rocky knolls
Agricultural infrastructure	small farm dam			poor fencing
Disturbance history				
Cropping				
Fire				
Over-grazing	yes	yes		
Flood damage (erosion)				
Heavy weed infestation				
Current agricultural condition				
% native grass cover	30	50	55	55
% exotic grass cover	5	0	0	25
% broad leaf weeds and natives	60	40	35	15
% bare ground / rock	5	10	10	5
Total	**100**	**100**	**100**	**100**
Regenerating woody vegetation		yes	yes	yes
Carrying capacity (DSE / ha)				
Current	**2**	**2.5**	**2.5**	**2.8**
Potential	**3.7**	**3**	**3.4**	**3.4**
Additional notes:				

Photo B.14 C10 survey site in Corridor Zone on Sunshine

Photo B.15 C11 survey site in Corridor Zone on Sunshine

Photo B.16 C12 survey site in Corridor Zone on Sunshine

Survey location				
Site ID	C13	C14	C14a	C15
Zone	Corridor	Corridor	Corridor	Corridor
Offset Area	Sunshine	Sunshine	Sunshine	Nioka North
Paddock ID	Hill toe	Big hill	Big hill	Rocky crop paddock
GPS	E: 248952	E: 248690	E: 248824	E: 248314
	N: 6607511	N: 6606927	N: 6606969	N: 6606718
Photo #	1804-1809	1791-1796	1797-1803	1745-1752
91-1796				
Native grassland (grazing)	yes			yes
Improved pasture (grazing)				
Grassy woodland (grazing)		yes		
Open woodland (grazing)				
Native regeneration (grazing)			yes	
Riparian woodland				
Current cropping				
Fallow				
Post cropping (grazing)				
Landform				
River / creek channel				
Alluvial plains / terraces				
Clay plain				
Hillside slopes	yes		yes	yes
Ridgeline		yes		
Landscape features	toe of hills, low undultaing ridgeline slopes	steep hills, rocky outcrops	midslope, steep, rock outcrops	small rocky knolls
Agricultural infrastructure	small farm dam			poor fencing
Disturbance history				
Cropping				
Fire				
Over-grazing	yes	yes		
Flood damage (erosion)				
Heavy weed infestation				
Current agricultural condition				
% native grass cover	30	50	55	55
% exotic grass cover	5	0	0	25
% broad leaf weeds and natives	60	40	35	15
% bare ground / rock	5	10	10	5
Total	**100**	**100**	**100**	**100**
Regenerating woody vegetation		yes	yes	yes
Carrying capacity (DSE / ha)				
Current	**2**	**2.5**	**2.5**	**2.8**
Potential	**3.7**	**3**	**3.4**	**3.4**
Additional notes:				

Photo B.17 C13 survey site in Corridor Zone on Sunshine

Photo B.18 C14 survey site in Corridor Zone on Sunshine

Photo B.19 C14a survey site in Corridor Zone on Sunshine

Photo B.20 C15 survey site in Corridor Zone on Nioka North

Survey location			
Site ID	C16	C17	C18
Zone	Corridor	Corridor	Corridor
Offset Area	Nioka North	Nioka North	Nioka North
Paddock ID	Contoured paddock	House paddock	Water paddock
GPS	E: 247744	E: 246345	E: 245243
	N: 6607066	N: 6607762	N: 6608287
Photo #	1732-1739	1720-1731	1710-1719
Vegetation and land use			
Native grassland (grazing)	yes	yes	
Improved pasture (grazing)			yes
Grassy woodland (grazing)			
Open woodland (grazing)			
Native regeneration (grazing)	yes	yes	
Riparian woodland			
Current cropping			
Fallow			
Post cropping (grazing)	yes		
Landform			
River / creek channel			
Alluvial plains / terraces			
Clay plain			
Hillside slopes	yes		yes
Ridgeline		yes	
Landscape features	midslope, contour banks	lower ridgeline / spur	lower slopes, undulating
Agricultural infrastructure	Contoured for historical cropping (~5 - 10 years ago)	concrete water tank x 2, fence moderate condition, house, shed, shipping container, swimming pool	concrete water tanks x 3, windmill, concrete water trough, scrapped metal tank, boundary fence
Disturbance history			
Cropping	yes		
Fire			
Over-grazing		yes (house yard)	
Flood damage (erosion)			
Heavy weed infestation			yes
Current agricultural condition			
% native grass cover	80	60	5
% exotic grass cover	0	5	20
% broad leaf weeds	15	10	75
% bare ground / rock	5	25	0
Total	**100**	**100**	**100**
Regenerating woody vegetation	yes	yes	
Carrying capacity (DSE / ha)			
Current	**3.5**	**2.8**	**3.5**
Potential	**4**	**3.5**	**4**
Additional notes:			

Photo B.21 C16 survey site in Corridor Zone on Nioka North

Photo B.22 C17 survey site in Corridor Zone on Nioka North

Photo B.23 C18 survey site in Corridor Zone on Nioka North

Survey location				
Site ID	C19	C20	C21	C22
Zone	Corridor	Corridor	Corridor	Corridor
Offset Area	Nioka North	Goonbri	Goonbri	Goonbri
Paddock ID	Contoured paddock	Woodland paddock	Woodland paddock	Woodland paddock
GPS	E: 247480	E: 235602	E: 235308	E: 235099
	N: 6606970	N: 6612817	N: 6612883	N: 6612823
Photo #	1740-1744	1769-1777	1778-1784	1785-1790
Vegetation and land use				
Native grassland (grazing)	yes			
Improved pasture (grazing)				
Grassy woodland (grazing)		yes	yes	yes
Open woodland (grazing)				
Native regeneration (grazing)	yes	yes	yes	
Riparian woodland				
Current cropping				
Fallow				
Post cropping (grazing)	yes			
Landform				
River / creek channel				
Alluvial plains / terraces				
Clay plain				
Hillside slopes	yes	yes	yes	yes
Ridgeline				
Landscape features	midslope low ridgeline	midslope low ridgeline	midslope low ridgeline	lower slopes, slightly undulating with minor drainage lines
Agricultural infrastructure	contoured for historical cropping (~5 - 10 years ago)	poor fencing along edge of zone	poor fencing along edge of zone	poor fencing
Disturbance history				
Cropping	yes			
Fire				
Over-grazing				yes patchy
Flood damage (erosion)				
Heavy weed infestation				
Current agricultural condition				
% native grass cover	85	60	45	45
% exotic grass cover	0	0	0	0
% broad leaf weeds	5	10	15	10
% bare ground / rock	10	30	40	45
Total	**100**	**100**	**100**	**100**
Regenerating woody vegetation	yes	yes		
Carrying capacity (DSE / ha)				
Current	**3.7**	**2.7**	**2**	**2.2**
Potential	**4**	**3.4**	**2.8**	**3.5**
Additional notes:				

Photo B.24 C19 survey site in Corridor Zone on Nioka North

Photo B.25 C20 survey site in Corridor Zone on Goonbri

Photo B.26 C21 survey site in Corridor Zone on Goonbri

Photo B.27 C22 survey site in Corridor Zone on Goonbri

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Appendix H

Soil management protocol

Boggabri Coal
Soil Management Protocol

November 2018

Boggabri Coal Pty Limited

BOGGABRI COAL PTY LIMITED
ABN 77 122 087 398
386 Leard Forest Road
Boggabri NSW 2382

Revision Control Chart

Rev No	Original	Revision A	Revision B	Revision C	Revision D
Revision Date	30/10/2015	7/06/2018	19/07/2018	20/07/2018	29/11/2018
Prepared by	S. Buchanan	S. Buchanan	S. Buchanan	S. Buchanan	A Cockerill
Reviewed by	R. Loch	D Martin			D Martin
Approved by	D. Martin				
Signed					

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Note this document is subject to periodic review and may contain amendments.

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List of Appendices

Abbreviations

Glossary	
BCOPL	Boggabri Coal Operations Pty Limited
BCM	Boggabri Coal Mine
BCEP	Boggabri Coal Expansion Project
BNC Conservation Area	Brigalow and Nandewar Community Conservation Area
BNC Act	Brigalow and Nandewar Community Conservation Area Act, 2005
BMP	Biodiversity Management Plan
Cwlth	Commonwealth
DoPI	Department of Planning and Infrastructure
DRE	Division of Resources and Energy
EA	Environmental Assessment
EMPs	Environmental Management Plans
EMS	Environmental Management System
EPA	NSW Environmental Protection Agency
EPBC Act	Environment Protection and Biodiversity Conservation Act, 1999
EP&A Act	Environmental Planning and Assessment Act, 1979
GPS	Global Positioning System
LEP	Local Environmental Plan
MOP	Mining Operations Plan
Mtpa	Million Tonnes Per Annum
OEH	NSW Office of Environment and Heritage
Project Approval	Part 3A Approval for continued mining operations at BCM, as approved 18 July 2012 by DoPI.
RMP	Rehabilitation Management Plan
ROM	Run of Mine
SIMP	Social Impact Management Plan
SMP	Soil Management Protocol

1. Introduction

This Soil Management Protocol (SMP) has been developed for the Boggabri Coal Project (the Project) on behalf of Boggabri Coal Operations Pty Ltd (BCOPL), a wholly owned subsidiary of Idemitsu Australia Resources Pty Limited (80%), Chugoku Electric Power Australia Resources Pty Ltd (10%) and NS Boggabri Pty Limited (10%). The Boggabri Coal Mine (BCM) is an existing mine located within and adjacent to the Leard State Forest, approximately 15 km northeast Boggabri in the Narrabri Shire local government area. The current operations include an open cut pit, infrastructure area, water management structures and a 17 km rail corridor to the Boggabri rail coal loading terminal.

BCM is located within an existing mining precinct, centred within and around the Leard State Forest, hereafter referred to as the Boggabri-Tarrawonga-Maules Creek Complex (BTM Complex[1]). The BTM Complex includes the existing Tarrawonga Coal Mine to the south and the Maules Creek Coal Mine to the northwest.

In 2009, BCOPL lodged a major project application (the Project) under the now-repealed Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act). In the project application, BCOPL sought to extend its mining operations for a further 21 years, and increase its production rate to 7 Mtpa of ROM coal from a total resource of 145 Mt. The Boggabri Coal Expansion project (BCEP) includes the operation of existing ancillary equipment; construction of a new coal handling and preparation plant; a 17 km rail spur line; bridges over the Namoi River and Kamilaroi Highway; a rail load-out facility located at the mine; an upgrade of the overburden and coal extraction haulage fleet (with an option for a drag-line); the upgrade of electricity transmission lines and other ancillary infrastructure.

1.1 Approval Conditions

The Project application was determined by the NSW Planning Assessment Commission (PAC), under delegation by the Minister for Planning and Infrastructure. Project approval was received in July 2012. Schedule 3 of the Project Approval received by Boggabri Coal Mine (BCM) requires the preparation of a Soil Management Protocol (SMP) to address conditions listed in Table 1.

Table 1. NSW Planning Assessment Commission Conditions

Condition		Document Section
36. The Proponent shall:		
a)	*develop a detailed soil management protocol that identifies procedures for:*	
	• *comprehensive soil surveys prior to soil stripping;*	Section 2
	• *assessment of topsoil and subsoil suitability for mine rehabilitation; and*	Section 2
	• annual soil balances to manage soil handling including direct respreading and stockpiling.	Section 3.3
b)	*maximise the salvage of suitable top-soils and sub-soils and biodiversity habitat components such as bush rocks, tree hollows and fallen timber for rehabilitation of disturbed areas within the site and for enhancement of biodiversity offset areas;*	Section 4.2

Federal approval was granted in February 2013 by the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC, now Department of the Environment (DoE)), under the Environment Protection and Biodiversity Conservation Act 1999.

[1] The BTM Complex is referred to as the Leard Forest Mining Precinct in the Project approval. Boggabri, Tarrawonga and Maules Creek management elected to replace reference to the Leard Forest Mining Precinct with BTM Complex.

Condition 22(b) and Condition 23(c) and (d) from Approval EPBC 2009/5256 outlines the soil management requirements for the Project (Table 2).

Table 2. Environment Protection and Biodiversity Conservation Act Conditions

Condition	Document Section
22. The person taking action must:	
b) not replace topsoil and subsoil layers at a depth less than the minimum depths determined through pre-stripping soil surveys as described in condition 23c.	Section 3.2
23. The Mine site rehabilitation plan must include, at a minimum, the following information:	
b) detailed depth surveys and analysis to inform the effective placement and restoration of soils underlying the proposed rehabilitation sites; including mapping of soils across the disturbance sites and soil sampling at no less than one sample point per 20 ha of each soil type identified. Sampling must identify; type, depth, water holding capacity, structure and physico-chemical properties of each of the soil and subsoil layers;	Section 2
c) processes and methodology for the removal, storage and re-layering of the top soil and sub soil layers underlying the disturbed sites being prepared for rehabilitation. These processes and methodologies must ensure the replacement of top soil and sub soil layers:	Section 4
a) meet the minimum depth requirements determined from sampling outcomes as identified in condition 23(c); and	Section 4
b) replicates other existing soil parameters including, but not limited to, soil type, water holding capacity, structure and physico-chemical properties.	Section 3

This SMP has been prepared in accordance with the relevant project approval conditions and provides BCOPL with a protocol for managing soils that require relocation as part of the approved mining activities at BCM.

1.2 Objectives of this SMP

The purpose of the SMP is to manage compliance as per the requirements of the aforementioned Project Approval conditions and the EPBC conditions, by demonstrating how these have either been met or by detailing how they will be addressed. Specifically this includes:

- Providing a summary of the outcomes of the soil survey undertaken pre-stripping and the quality of soil materials encountered;
- Providing summary details and criteria of the soil-vegetation-landscape associations, as determined by the soil survey, that are relevant to rehabilitation;
- Detailing the requirements for placement of the soil/spoil materials for target vegetation communities (domains);
- Developing procedures for annual soil balances to manage soil handling, including respreading and stockpiling; and
- Developing procedures to maximise the salvageable volume of suitable top-soils and sub-soils and biodiversity habitat components, such as bush rocks and tree hollows, for rehabilitation of disturbed areas within the site and for enhancement of biodiversity offset areas.

1.3 Performance Criteria

The performance criteria to evaluate performance against the objectives of this SMP include:

- Reinstated topsoil will aim to have *texture and chemical fertility* within the range of naturally occurring topsoils of the target rehabilitation vegetation community.
- Reinstated topsoil will aim to be managed to develop soil *organic matter* levels within the range that naturally occurs in topsoils for the target rehabilitation vegetation community.
- Reinstated growth media will aim to have *water holding capacity, permeability*, and *runoff* attributes within the range that naturally occurs in soils for the target vegetation community.
- Reinstated growth media *depth* will aim to be within the range that naturally occurs in soils for the target vegetation community.
- Reinstated growth media subsoil/substrate will aim to have no more inhibiting *physical or chemical limitations* than those within the range that naturally occurs in soils for the target vegetation community.

2. Soils within Primary Mine Disturbance Area

2.1 Soil Types

A soil survey was undertaken in 2014 to develop a growth media inventory for the Boggabri Coal Expansion Project BCEP and Transport Corridor in reference to the Project Approval Conditions.

This survey was completed at a scale of 1:25 000 comprising of 108 sites across the 1978 ha study area (~ 1 site 18 ha). Specifically, the study area included:

- BCM Area (1664 ha) within mining leases ML A355 and ML A339; and
- BCEP Rail Corridor (314 ha), which is 19 km long and extends from the mine to the load out facility.

Findings of this assessment are detailed in the report titled *'Boggabri Coal Project – Soil survey and growth media inventory for rehabilitation (Landloch 2014)*. The report includes details of soil depth, water holding capacity, erodibility, structure and physico-chemical properties of each of the soil and subsoil layers of all of the soil types (soil profile classes) of the study area. An assessment of topsoil and subsoil suitability for mine rehabilitation is also included in the report.

Summary details of the soils occurring within the Primary Mine Disturbance Area (ML A355 and ML A339) are given in Table 3.

Table 3. Soils occurring within the Primary Mine Disturbance Area

Soil Types	Description	Key Features
Maules Gravelly Sands (Shallow Depth & Moderate Depth Phases)	Gravelly to very gravelly sands formed on the sedimentary Maules Creek Formation. Shallow depth phase is predominant and on hill crests and upper slopes. Deeper profiles (Moderate Depth Phase) are typically found at mid-slopes, lower-slope, and footslope locations.	Uniform textured soils of loamy sand or clayey sand. Typical depths of Shallow Phase are 0.3–0.5 m and Moderate Depth Phase 0.6–1.1 m. Topsoil fertility rating is *moderate to high.* Total N: moderate; Available P: high; Available K: high; Organic Carbon: very high. Subsoil pH is neutral to low acidity, non-saline and marginally sodic, and sometimes dispersive. Effective rooting depth: Shallow Phase, 0.3–0.5 m; Moderate Depth Phase, 0.6–1.0 m. Water holding capacity: Shallow Depth Phase, 40–75 mm; Moderate Depth Phase, 75–150 mm.

Soil Types	Description	Key Features
		Estimated soil erodibility (*K*–factor): Topsoil: low–moderate; Subsoil: moderate.
Maules Gravelly Loams (Shallow Depth & Moderate Depth Phases)	Gravelly to very gravelly loams formed on the sedimentary Maules Creek Formation. Shallow depth phase is found on hill crests and upper slopes. Deeper profiles (Moderate Depth Phase) are typically found at mid-slopes, lower-slope, and footslope locations.	Uniform or gradational soils that are gravelly to moderately gravelly (< 50% gravel). Clay content tends to increase with depth with loamy sand or clayey sand topsoil and sandy clay loam to clay loam subsoils. Typical depths of Shallow Phase are 0.3–0.5 m and Deep Phase 0.6–1.0 m. Topsoil fertility rating is *moderate to high.* Total N: moderate; Available P: high; Available K: high; Organic Carbon: very high. Subsoil is highly acidic, non-saline, marginally sodic and non-dispersive. Effective rooting depth: Shallow Phase, 0.3–0.4 m; Moderate Depth Phase, 0.6–1.0 m. Water holding capacity: Shallow Depth Phase, 30–75 mm; Moderate Depth Phase, 75–150 mm. Estimated soil erodibility (*K*–factor) – Topsoil: low–moderate; Subsoil: moderate.
Maules Gravelly Duplex	Gravelly, moderately deep texture contrast soils on slopes formed on the sedimentary Maules Creek Formation, and includes both sodic and non sodic subsoils.	Texture contrast soils that are slightly to moderately gravelly (< 50 % gravel). Depth to weathered rock is generally less than 1.5 m. Topsoil fertility rating is *moderate to high.* Total N: moderate; Available P: moderate; Available K: high; Organic Carbon: high to very high. Subsoil pH ranges from low acidity to highly alkaline with low to moderate salinity; and is sometimes sodic and generally dispersive. Effective rooting depth: 0.6–1.0 m. Water holding capacity: 75-150 mm. Estimated soil erodibility (*K*–factor) – Topsoil: low–moderate; Subsoil: moderate.
Maules Sodic Duplex	Moderately deep to deep, texture contrast soils with sodic subsoils on footslopes and valley flats formed over colluvium.	Texture contrast soils with sodic subsoils underlain with colluvium at ~ 1.5 m. Topsoil fertility rating is *moderate.* Total N: moderate; Available P: low to moderate; Available K: high; Organic Carbon: high to very high. Subsoil pH ranges from highly acidic to highly alkaline with salinity increasing with depth from low to high. It is sodic to highly sodic and dispersive. Effective rooting depth: 0.5–1.0 m. Water holding capacity: 75-175 mm. Estimated soil erodibility (*K*–factor) – Topsoil: low–moderate; Subsoil: moderate.

2.2 Soil Landscapes

Soil landscapes reflect the variations in soil type, geology, landform, drainage and vegetation within the study area. All soil landscape units have some soil variation, and generally include more than one soil profile class.

Details of the soil landscapes and corresponding soil profile classes identified in the Primary Mine Disturbance Area are given in Table 4, and are present in Appendix A. The soil landscapes have been developed with reference to the soil landscapes presented in the *Soil and Land Resources of the Liverpool Plains Catchment Interactive DVD* (Office of Environment and Heritage, 2012).

Table 4. Summary descriptions of the Soil Landscapes within the Primary Mine Disturbance Area

Soil Landscapes	Landform and Geology	Soil Types
Leard	Crests and upper slopes of low hills on the Maule's Creek Formation, sometimes extending to mid slopes. Moderately inclined slopes with to 8–30% gradient.	Maules Gravelly Sands-Shallow Depth Phase (40–60%); and Maules Gravelly Loams-Shallow Depth Phase (40–60%).
Blue Vale Slopes	Mid to lower slopes of low hills on the Maule's Creek Formation. Gently inclined slopes of 3–10 % gradient.	Gravelly Duplex (70–90 %), Maules Gravelly Sands-Moderate Depth Phase (10–20%); and Maules Gravelly Loams-Moderate Depth Phase (10–20 %).
Blue Vale Footslopes	Drainage fans and plains derived from the Maule's Creek Formation. Footslopes of < 4 % gradient.	Maules Sodic Duplex Soils (80–90 %); Maules Gravelly Loams-Moderate Depth Phase (5–15 %); and Maules Gravelly Sands-Moderate Depth Phase (5–15 %).
Brentry[*1]	Drainage plains and fans formed on Quaternary alluvium derived from the Maule's Creek Formation. Footslopes of < 4 % gradient.	Maules Sodic Duplex Soils.

[*1] The *Brentry* soil landscape is outside the Primary Mine Disturbance Area and is not intended to be cleared for mining. Details have been included in the table as they are relevant to the establishment of *Growth media criteria for revegetation domains in* Table 9.

Details of the vegetation community's associated with each soil landscape are presented in Table 5. They correspond closely with the Revegetation Domains included in the *Rehabilitation Management Plan* (BCM, 2015).

Table 5. Summary descriptions of the Soil Landscapes within the Primary Mine Disturbance Area

Soil Landscapes	Associated Vegetation[*2]
Leard	Ironbark- Pine Woodland. Dominant tree and shrub species include *Callitris glaucophylla* (white cypress pine), *Callitris endlicheri* (black cypress pine), *Eucalyptus crebra* (narrow-leaved ironbark), *E. melanophloia* (silver-leaved ironbark), *E. sideroxylon* (mugga ironbark), localised *E. albens* (white box), *Acacia cheelii* (motherumbah), *Notelaea microcarpa* (native olive).
Blue Vale Slopes and Blue Vale Footslopes	White Box, Grey Box Ironbark- Pine Open Woodland. Dominant tree species including *E. albens, E. sideroxylon*, *E. melanophloia, E. crebra, E. populnea* (bimble box), *E. pilligaensis* (narrow-leaved grey box), *E. dealbata* (tumbledowngum), *Allocasuarina distyla* (scrub she-oak), *Notelaea microcarpa, Beyeria viscosa* (sticky wallaby-bush), *Olearia elliptica* (sticky daisy bush), *Ehretia membranifolia* (peach bush), *Geijera parviflora* (wilga), *Alectryon oleifolius* (rosewood), *Callitris glaucophylla,* and *Callitris endlicheri.*
Brentry	Yellow Box, Red Gum, Ironbark-Pine Open Woodland. Major tree and shrub species are *Eucalyptus populnea* (bimble box), *E. sideroxylon*, E. moluccana (grey box), *E. macrocarpa* (western grey box), *E. pilligaensis* (pilliga grey box), *E. crebra, E. melanophloia,* localised *E. albens*, *E. dealbata*, *E. blakelyi* (Blakely's red gum), *E. conica* (fuzzy box), *Allocasuarina luehmannii* (bull oak), *Callitris glaucophylla, Notelaea macrocarpa*, *Beyeria viscosa* (sticky wallaby-bush), *Olearia elliptica* (sticky daisy bush) and occasional examples of *Cadellia pentastylis* (ooline), a vulnerable tree species. *E. melliodora* (yellow box), *E. blakelyi* (Blakely's red gum), *Angophora floribunda* (rough-barked apple) and *Melaleuca bracteata* (white cloud tree) occur along drainage lines.

[*2] Associated Vegetation is based on that described by *Soil and Land Resources of the Liverpool Plains Catchment Interactive DVD* (Office of Environment and Heritage, 2012). Listed are the dominant tree species. The publication also includes lists of the groundcover species.

2.3 Salvageable Soil

Soil material depths for the different quality growth media materials within each soil landscape unit are provided in Table 6.

Option A

Table 6a. Soil material depths (mm) from the soil landscapes yet to be disturbed (adapted from Landloch, 2014).

Soil Landscape	Topsoil (mm)	Subsoil (mm)	Marginal Subsoil
Leard	200	Nil - too rocky[A]	Nil - too rocky
Blue Vale Slopes	200	200–600	600–1200 (sodic, sometimes moderately saline)
Blue Vale Footslopes	200	200–500	500–1200 (sodic, sometimes moderately saline)

Notes: A. There are subsoil materials in the Leard soil landscape; however it is expected these will be difficult to recover due to the presence of shallow rock. Therefore as a conservative measure it is assumed subsoil materials will not be recovered from this area.

Volume estimates of the growth media materials that are potentially available as at 2018 are presented in Table 7. These include existing stockpiled materials, and estimated volumes from areas yet to be disturbed.

Option A - Total salvable soil 6,488 000 cum. Max stripping depth 1.2m

Table 7a. Salvageable growth media quantities available for rehabilitation at 2018.

Location	Area	Topsoil		Subsoil		Marginal Subsoil	
		Thickness	Volume	Thickness	Volume	Thickness	Volume
	(ha)	(m)	(x 1000 m^3)	(m)	(x 1000 m^3)	(m)	(x 1000 m^3)
Stockpiled	N/A	N/A	2046	N/A	N/A	N/A	N/A
Leard	313	0.2	626	0	0	0	0
Blue Vale Slopes	302	0.2	604	0.4	1208	0.6	1,812
Blue Vale Footslopes	16	0.2	32	0.3	48	0.7	112
	631		**3308**		**1256**		**1,924**

2.4 Potential Growth Media – Spoil Materials

The spoil materials have been characterised as being strongly alkaline, sodic, with generally low salinity (Table 8). The gypsum rate to ameliorate sodicity is calculated to be 1–3 kg/m^3.

The estimated water holding capacity of the spoil material is 50 mm/m, based on the materials having sandy clay texture and an appreciable rock content of 20–40% (DLWC, 1999; Landloch, 2016).

Of note is the high alkalinity of the spoil materials. Such elevated alkalinities are outside the range recommended for plant growth (pH 5.5–8.5) as it can lead to nutrient deficiently and toxicity disorders. However, there are no obvious indicators to suggest severe nutritional disorders are occurring. Since active rehabilitation commenced in 2008 there are areas where trees have grown to 6 m within six years of planting tubestock. Records also show that roots have been growing well into the spoil materials (Landloch, 2016). It is hypothesised that the surface capping layer of topsoil is the primary source of fertility for vegetation, while the spoil materials are storing water for photosynthetic needs.

Table 8. Physico-chemical characteristics of spoil materials (adapted from Landloch, 2016)

Parameter	Mean	$CI_{95\%}$	10% ile	90% ile
pH	8.9 (high alkalinity)	0.2	7.9 (low alkalinity)	9.4 (very high)
EC (dS/m)	0.3 (moderately saline)	0.1	0.1 (low salinity)	0.4 (moderately saline)
ESP (%)	10.1 (sodic)	2.9	3.8 (non-sodic)	20.1 (very high)
EAT	1 (strongly dispersive)	-	1 (strongly dispersive)	2 (dispersive)

Notes: EC: Electrical conductivity (salinity); ESP: Exchangeable sodium percentile (sodicity); and EAT – Emmerson Aggregate Test (dispersion and slaking).

3. Growth Media Requirements

The Rehabilitation Management Plan (RMP) provides details on the rehabilitation of the Project. According to the RMP there are three broad vegetation communities proposed for the revegetation of the Primary Mine Disturbance referred to as:

- *Grassy Woodland* (Domain A) dominated by *Callitris glaucophylla* (white cypress pine), *E. albens* (White Box*), E. pilligaensis* (Grey Box), and; *E. crebra* (narrow-leaved ironbark).
- *Riverine Woodland* (Domain B) dominated by *Callitris glaucophylla* (white cypress pine), *E. crebra* (narrow-leaved ironbark), *E. blakelyi* (Blakely's red gum), and *E. melliodora* (yellow box).
- *Shrubby Woodland* (Domain C) dominated by *Callitris glaucophylla* (white cypress pine), *E. crebra* (narrow-leaved ironbark), and *E. melanophloia* (silver-leaved ironbark);

These revegetation domains broadly correlate with the soil landscape vegetation communities associated with the *Blue Vale* Domain A , and *Brentry* Domain B and *Leard*– Domain C.

3.1 Growth Media Targets for Revegetation Domains

The growth media requirements for these Revegetation Domains have been developed based on correlation with soil landscape data from the pre-disturbance soil survey (Landloch 2014) and the *Soil and Land Resources of the Liverpool Plains Catchment Interactive DVD* (Office of Environment and Heritage, 2012). The growth media targets for Revegetation Domains are provided in Table 9.

Table 9. Growth Media Targets for Revegetation Domains

Properties	Domain A Grassy Woodland	Domain B Riverine Woodland	Domain C Shrubby Woodland
Gradient	3-10 %	0-3%	8–30%
Texture	Gravelly gradational sands and loams and texture contrast soils.	Gravelly gradational sands and loams and texture contrast soils.	Gravelly gradational sands and loams.
Drainage	Ranging from well drained to imperfectly drained.	Ranging from well drained to poorly drained.	Well drained.
Effective Rooting Depth	>0.6 m	>0.5 m	>0.4m
Topsoil depth	~150 mm	~150 mm	>100 mm
Organic Carbon 0-0.1m	> 2%	> 2%	> 2%
Phosphorous 0-0.1m (Colwell)	20–40 mg/kg	20–40 mg/kg	20–40 mg/kg
$pH_{w1:5}$ < 0.3 m	5.5–8.0	5.5–8.0	5.5–8.0
Salinity: Low **Salinity: Low/Moderate**	<0.3 m < 0.6 m	<0.3 m <0.5 m	<0.3 m <0.4 m
Sodicity < 6 %	<0.3 m	<0.3 m	<0.3 m

Properties	Domain A Grassy Woodland	Domain B Riverine Woodland	Domain C Shrubby Woodland
Sodicity < 15	< 0.6 m	<0.5 m	<0.4 m
Water Holding Capacity		80–175 mm	65–175 mm

Notes: Salinity - Low (< 0.3 dS/m or Cl <400 mg/kg); Salinity - Low/Moderate (< 0.6 dS/m, Cl < 800 mg/kg).

3.2 Growth Media Criteria for Revegetation Domains

The growth media criteria for Revegetation Domains is presented in Table 10. These criteria have been developed to meet the requirements for the Revegetation Domains detailed Table 9.

Table 10a. Growth media criteria for Revegetation Domains

	Domain A Grassy Woodland	Domain B Riverine Woodland	Domain C Shrubby Woodland
Topsoil Thickness	0.2 m	0.2 m	0.15 m
Topsoil Source - Preferred	Blue Vale	Brentry	Leard
Topsoil Source - Alternate	Brentry or Leard	Blue Vale or Leard	Blue Vale or Brentry
Subsoil Thickness	0.3 m	0.3 m	0.2 m
Spoil Amendment [A]	0.6 m	0.6 m	0.6 m
Spoil gypsum application rate	10 t/ha	10 t/ha	10 t/ha
Water Holding Capacity-Predicted	90–120 mm	90–120 mm	70–90 mm

Notes: A- Gypsum incorporation and ripping depth into spoil.

3.3 Soil Balance

An inventory of soil balance must be maintained as per Approval Condition (Section 1). The inventory of soil materials will be tracked, in part, using *Soil Recovery Records* and *Rehabilitation Records* is (Section 4).

The total area of rehabilitation is approximately 1500 ha. Approval condition (insert) requires that at least 650 ha be vegetated with Doman A and Domain B vegetation communities. Volume estimates of soil materials are provided in Table 11, based on the growth media requirements for these vegetation communities (Table 9 and Table 10).

Table 11a. Growth media quantities required for rehabilitation.

	Domain A	Domain B	Domain C	Totals	Salvageable [C]
Area (ha)	500	150	850	1,500	N/A
Topsoil (1000 m^3)	1,000 [B]	300 [B]	1,275 [A]	2,575	3,308
Subsoil (1000 m^3)	1,500[C]	450 [C]	1,700[B]	3,650	3,180
Totals (1000 m^3)	2,500	750	2,975	**6,225**	**6,488**

Notes:

Bulking factor has not been applied to stripping volumes.

A- Placement depth 0.3m

B- placement depth 0.15m

C- Placement depth 0.15m

D- Data from Table 7a.- max strip 1.2m

4. Management Protocols

Details on key aspects of topsoil, subsoil and spoil management for the mine disturbance area are outlined in this section.

4.1 Soil Handling Records

An inventory of soil movement must be maintained to manage the soil handling, including direct return and stockpiling throughout the life of the mine. The following tasks will be developed and maintained to track soil balance for the life of the mine.

- *Soil Recovery Records* - to track the recovery of soil material. It includes soil data details such as: where soil materials were recovered from; where materials were taken to, stripping depths and volumes, and gypsum amelioration rates.
- *Rehabilitation Records* - to detail the methodology applied in each rehabilitation campaign. It records details such as: topsoil and subsoil source, depth applied, soil preparation, gypsum and fertiliser rates, seed mixes and tub stock species planted.

An example *Soil Recovery Record* and *Rehabilitation Record* is provided in Appendix C.

4.2 Soil Stripping

Double stripping is required to meet with approval conditions (Section 1). This involves the removal of the topsoil materials and upper subsoil materials in separate operations, so that soil layers can be reinstated in a layered manner similar to the original condition. It produces a salvaged topsoil with minimal dilution of fertility, and limits the burial of the seedbank to depths that are too great for the seed to emerge after germination.

The process for stripping soil materials is to:

- Clearly demarcate the area to be stripped of soil;
- Apply gypsum at the designated rate for the depth and growth media materials prior to recovery;
- Avoid working soils in wet condition to minimise the destruction of soil structure;
- Maintain records of direct return/stockpile locations, the date established, as well as the area, volume and source of materials.
- Record the nature and quantities of salvaged bush rocks, timber etc. to ensure that the salvage of these items is maximised, in accordance with protocols outlined in the Rehabilitation Management Plan.

4.3 Soil Stockpiling

Direct return should always be encouraged rather than stockpiling because it better preserves seed viability. Current topsoil reuse and stockpile management at BCOPL demonstrates that forest topsoil contains a large quantity of seeds stored in the topsoil. This is an important reserve of indigenous plant seed and soil microflora, which will assist with the preservation of local genetic material and the re-establishment of a range of species similar to the original vegetation in the rehabilitation area.

Where stockpiling is unavoidable, the following process is to be followed:

- Stockpile heights should ideally range up to 0.6 m, but are not to exceed 3 m in order to preserve soil quality and the seedbank of native vegetation.

- Stockpiling for periods of greater than six months should be avoided so as to minimise the amount of seed and microorganisms perishing.
- Stockpiles that will remain for longer than two months will be seeded to provide a faster stabilisation of the soil surface, improve infiltration, increase nitrogen and organic matter content, and encourage micro-organisms and the establishment of native plants from the soil seed bank.
- Supplementary seeding / plantings may be necessary if the stockpiling results in a substantial loss of seedbank, such that it hampers achieving the species diversity objectives within the RMP.
- The surface of soil stockpiles will be shaped in a manner to promote infiltration and minimise erosion until vegetation is established. Examples include undulating dump mounds and ripping of the surface.
- Stockpiles will be located in areas away from drainage lines. Run-on will be diverted around the stockpiles to prevent erosion and waterlogging. Sediment controls will be installed downslope from stockpiles where there is a risk of contamination of clean water.
- Records will be maintained of the stockpile locations, date established, area, volume and source of materials.
- Prior to use in rehabilitation, an assessment will be undertaken of weed infestation and what remedial actions might be appropriate.

4.4 Respreading Soil Materials

Topsoil and subsoil requirements for rehabilitation domains have been designed to achieve the growth media criteria requirements for the targeted vegetation communities.

Material will be spread in even layers at an appropriate thickness to meet the growth media placement requirements for Rehabilitation Domains (Table 10). Further details on rehabilitation methods are discussed in the *Rehabilitation Management Plan*.

In practice, respreading of soil materials will involve:

1. Application of gypsum to the spoil prior to the final trim so that it can well incorporated with earthworks.
2. Ripping spoil to target depth of 0.6 m with final trim earthworks.
3. Placement of subsoil and spreading to a thickness of ~0.3 m.
4. Placement of topsoil and spreading to a thickness of ~0.15 m.
5. Ripping the final surface along the contour to a depth of ~0.5 m in preparation for planting and/or sowing.

An important consideration for reinstating topsoil materials is the accuracy with which heavy machinery can control layer depths when reinstating the topsoil. As a ‘general rule’, on moderate gradient slopes, heavy machinery can typically achieve tolerances of +/- 50 mm of the target soil layer depth. Hence, aiming for an average target depth of ~150mm will result in areas with minimal dressing of ~ 100 mm of topsoil. Attempting to spread topsoil to less than the target depths i.e. 100 mm +/- 50 mm will result in areas with only 50 mm of dressing in places. This may present limitations to plant establishment in those areas, and will eventually result in bare scalds across the rehabilitated area once a small amount of erosion occurs.

4.5 Deep Ripping

Deep ripping mechanically breaks up compacted spoil/subsoil layers and allows water infiltration and root penetration. It is also critical for the incorporation of gypsum to address the sodicity of materials.

Deep ripping can be achieved using a variety of implements and machinery including dozers equipped with three or four tines that are further apart or specific farm cultivation equipment with multiple tiers of tines close together (e.g. subsoilers). Depending on the equipment being used and the field conditions, multiple offset passes over the same area and cross ripping may be necessary to achieve the desired results.

To achieve adequate incorporation of additives for amelioration to occur, the deep ripping needs have the ripped material in the target depth (e.g. 0.3 m – 0.5 m) with rip lines less 0.3 m – 0.5 m apart. Where incorporation of additives is not required, the spacing of ripping lines can be increase up to 1.0–1.5 m.

Ripping should be parallel to the contour.

4.6 Amelioration

Mine spoil and some soil materials will require amelioration of sodicity to mitigate dispersion and the restrictions to plant growth such as crusting and hard setting. These limitations can lead to seedling emergence, reduced infiltration and water capture, and result in increased runoff and erosion.

Gypsum for amelioration of sodicity in:

- Soil should be applied prior to soil stripping so it may be well incorporated during materials handling;
- Spoil should be applied prior to the final trim rs and incorporated by ripping (Section 4.5).

The rate of gypsum required is a function of a number of factors including: sodicity and physico-chemical chemical properties of materials; what vegetation domain they will be required to support; and at what depth the materials will be placed. Gypsum amelioration rates are provided in Table 12 and Appendix B.

Option A - Max strip depth 1.2m.

Table 12. Gypsum amelioration rates

Area	Material	Depth Range (m)	Thickness Treated (m)	Rate (t/ha)
Leard	Topsoil	0.0–0.2	0.2	Nil
	Subsoil	0.2–0.4	0.2	2
Blue Vale Slopes	Topsoil	0.0–0.2	0.2	2
	Subsoil	0.2–0.6	0.4	7
	Marginal Subsoil	0.6–1.2	0.6	5
Blue Vale Footslopes	Topsoil	0.0-0.2	0.2	2
	Subsoil	0.2–0.5	0.3	7
	Marginal Subsoil	0.5-1.2	0.7	20
Rehabilitation Domains A, B & C	Spoil	N/A	0.6	10

4.6.1 Gypsum incorporation into topsoil materials

The topsoil materials across the Primary Mine Disturbance Area generally are non-sodic. However, when stripped they can inadvertently become contaminated by any sodic subsoil materials that are captured with topsoil. Where this can occur, low rates of gypsum are to be applied to topsoil materials during stripping.

4.6.2 Gypsum incorporation to subsoil materials

Subsoil materials are commonly sodic and typically grade from mildly sodic in the upper subsoil to strongly sodic with depth. Amelioration of sodicity with gypsum will be required when these materials are to be used as plant growth media and placed for rehabilitation. Gypsum should be applied to the subsoil materials at stripping, to allow thorough incorporation by the stripping process and the cation exchange process to commence.

4.6.3 Gypsum incorporation to spoil materials

Spoil materials are commonly sodic and will require amelioration with gypsum when these materials are to be used as plant growth media and placed immediately below respread soil. Gypsum should be applied to the spoil materials and ripped to the target depth (e.g. 0.3 m–0.5 m) prior to dressing with topsoil.

4.6.4 Adjustment to pH of alkaline spoil

Amelioration of alkalinity of spoil materials is considered largely impracticable and does not appear to be warranted at present, based on the positive projection to-date of vegetation growth in rehabilitated areas.

4.7 Fertiliser Requirements

Applications of fertiliser to topsoil will be beneficial to promote vegetation establishment and plant growth. Bulk disturbance of topsoil materials has the potential to dilute fertility where surface materials are mixed with less fertile sub-surface layers. Bulk disturbance can also result in nitrogen loss via increased rates of organic matter mineralisation forming mineral nitrogen that may be leached or lost by volatilisation.

In principle, if topsoil is stripped as prescribed in this SMP and then directly returned (i.e. not stockpiled) then the loss of fertility should be relatively low. Therefore, addition of fertiliser should aim to promote early establishment of vegetation and off-set nitrogen drawdown cause by incorporation of mulch. Fertiliser application should include:

- Mono-ammonium phosphate (MAP) (150 kg/ha) (N: 10%, P: 20%, K: 0%, S: 1%); and
- Coated urea (100 kg/ha).

The 150 kg/ha of MAP will supply approximately 30 kg of phosphorus and 15 kg nitrogen per hectare. Coated urea applied at 100 kg/ha will provide a slow release source of nitrogen (~45 kg/ha) for plants over several months.

Trials could be adopted to further refine application rates and types of fertiliser.

4.8 Sampling and Analysis

Sampling and analysis will be undertaken when:

- Validation is required of the Rehabilitation Domains in each rehabilitation campaign;
- There are concerns in the performance of vegetation;
- The locations from where soil materials are being removed have a low or poor degree of vegetation cover; or if

- There has been a deviation from the soil management procedures outlined in this document that may have led to:
    - Mixing of subsoil materials in with topsoil materials, or
    - Failure to apply gypsum at the correct rate prior to soil recovery.

Laboratory analysis is to be undertaken by a laboratory with National Association of Testing Authorities (NATA) certification and uses Australian Soil and Plant Analysis Council (ASPAC) accredited laboratory methods. Laboratory analytical suites are provided in Table 13.

Table 13. Laboratory analytical suites

Analysis	Topsoil	Subsoil/Spoil
Total nitrogen and phosphorous; available phosphorous, potassium, and sulphur; organic carbon and micronutrients	✓	
Phosphorous buffering index (PBI)	✓	
Field texture and colour	✓	✓
Soil pH and electrical conductivity	✓	✓
Exchangeable cations (with calculations of effective cation exchange capacity and exchangeable sodium percentage)	✓	✓
Dispersion potential (Emerson)	✓	✓

Validation of Rehabilitation Domains should be undertaken with each rehabilitation campaign. The sampling rate should be the greatest of either:

- three sites per rehabilitation campaign, or
- one site per 20 ha.

Sample analysis should be collected at intervals of 0.0-0.1m, 0.2-0.4m, 0.5-0.7m, 0.7-0.9m, and 1.0–1.2m. Topsoil samples will be composite samples consisting of a 5–10 sub-samples from within a 10 m radius, to accommodate heterogeneity in topsoil materials.

Sampling and analysis will be determined on an as-needs basis for reasons other than validation of Rehabilitation Domains (e.g. mixing of subsoil with topsoil).

Additional samples may be collected at the time of sampling (e.g. collect twice as many samples). Extra analysis may be required if the analytical program is insufficient to adequately characterise the materials (e.g. if materials are overly variable and heterogeneous).

5. Monitoring

The soil management process will be monitored to ensure the health of the soil is maintained and the rehabilitation and biodiversity performance criteria in the RMP is achieved.

Soil parameters in rehabilitated areas will be monitored during the annual rehabilitation monitoring program.

The annual rehabilitation monitoring will be used to assess the performance against the Trigger Action Response Plan (TARP). This willidentify the triggers for soil performance and, where required, provide for an action response (refer Appendix E of RMP).

6. Roles and Responsibility

The soil management protocol will be implemented by the personnel outlined in Table 14 to meet the objectives of this protocol.

Table 14. Roles and Responsibilities

Role	Document accountabilities, consultation and informed personnel
General Manager BCOPL	Provide sufficient resources for the effective implementation of this protocol.
Operations Manager	Coordinate the mining contractor and employees to implement this protocol.
Environmental Superintendent	Coordinate and or delegate any required monitoring, supervising, reporting and revisions of this protocol; Where required consult with the relevant stakeholders on the monitoring and management measures; Where required inform the General Manager and Operations Manager on the implementation of this protocol; and Inform the General Manager and Operations Manager of any incidents or non-conformances with this protocol.
Mining Contractor	Ensure all contracted work is undertaken in accordance with this protocol; Coordinate employees to undertake work in accordance with this protocol; and Inform the Environmental Superintendent of any incidents or non-compliances with this protocol.
All Employees and Contractors	Comply with all requirements of this plan; and Inform the Environmental Superintendent of any non-compliance with this protocol.

7. Reporting

Soil and rehabilitation documentation will be assessed and reported annually as part of the Annual Environmental Management Report (AEMR). Results of the assessments will be incorporated into future reviews of this Soil Management Protocol and the Rehabilitation Management Plan.

8. References

8.1 Internal

The RMP forms a part of the BCOPL Environmental Management Strategy and the following documents should be referenced for further information relating to environmental management:

- BCOPL Biodiversity Management Plan
- BCOPL Rehabilitation Management Plan
- BCOPL Cultural Heritage Management Plan
- BCOPL Environmental Incident Response Management Plan

8.2 External

- DLWC (1999). Soil and Regolith Attributes for CRA/RFA Model Resolution: Upper North-east and Lower North-east CRA Regions. NSW Department of Land and Water Conservation, NSW State Forests, NSW National Parks and Wildlife Service and Bureau of Rural Sciences (Canberra).
- Landloch (2012). Boggabri Coal Mine. Conceptual Final Landform Study.
- Landloch, (2014) Boggabri Coal Project - Soil Survey and Growth Media Inventory for Rehabilitation.
- Landloch, (2016) Boggabri Coal Operations – Preliminary Evaluation of Growth Media within the 2018–2014 Rehabilitation Areas.
- McKenzie N.J., Grundy M.J., Webster R., and Ringrose-Voase A.J. (2008). Guidelines for surveying soil and land resources. 2nd edition, Volume 2 Australian Soil and Land Survey Handbook Series, CSIRO Publishing.
- Mullen, R., Lentz, E., and Watson, M. (2007). Soil Acidification: How to lower soil pH. Extension Factsheet. School of Environment and Natural Resources, Ohio.
- Soil and Land Resources of the Liverpool Plains Catchment Interactive DVD (Office of Environment and Heritage, 2012).

Appendix A

Soil Landscape Map

800,000

805,000

6,610,000

6,610,000

Project Boundary

Soil Landscapes

Leard

Blue Vale

Blue Vale Footslopes

800,000

805,000

Meters

0 250 500 1,000

Version: Rev 0
Drawn By: Simon Buchanan
Date: September 2018
Reviewer: S Buchanan
Approver: Simon Buchanan

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

Landloch

Boggabri Coal Mine
Soil Management Protocol
Figure 1 - Soil Landscapes

Appendix B

Soil Recovery Maps

800,000

6,610,000

800,000

Project Boundary

Topsoil Stripping Depth

200 mm

Gypsum Rate

0 t/ha

2 t/ha

Meters
0 125 250 500

Version: Rev 0
Drawn By: Simon Buchanan
Date: September 2018
Reviewer: S Buchanan
Approver: Simon Buchanan

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

Landloch

Boggabri Coal Mine
Soil Management Protocol
Figure 2 - Topsoil Stripping

800,000

6,610,000

Project Boundary

Upper Subsoil Stripping Thickness

300 mm (Lower depth 0.5 m bgl)

400 mm (Lower depth 0.6 m bgl)

Gypsum Rate

7 t/ha

800,000

Meters
0 125 250 500

Version: Rev 0
Drawn By: Simon Buchanan
Date: September 2018
Reviewer: S Buchanan
Approver: Simon Buchanan

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

Landloch

Boggabri Coal Mine
Soil Management Protocol
Figure 3 - Upper Subsoil Stripping

800,000

6,610,000

Project Boundary

Lower Subsoil Stripping Thickness

600 mm (Lower stripping depth 1.2m)

700 mm (Lower stripping depth 1.2m)

Gypsum Rate

7 t/ha

20 t/ha

800,000

Meters
0 125 250 500

Version: Rev 0
Drawn By: Simon Buchanan
Date: September 2018
Reviewer: S Buchanan
Approver: Simon Buchanan

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

Landloch

Boggabri Coal Mine
Soil Management Protocol
Figure 4 - Lower Marginal Subsoil Stripping

Appendix C

Example Soil Management Documents

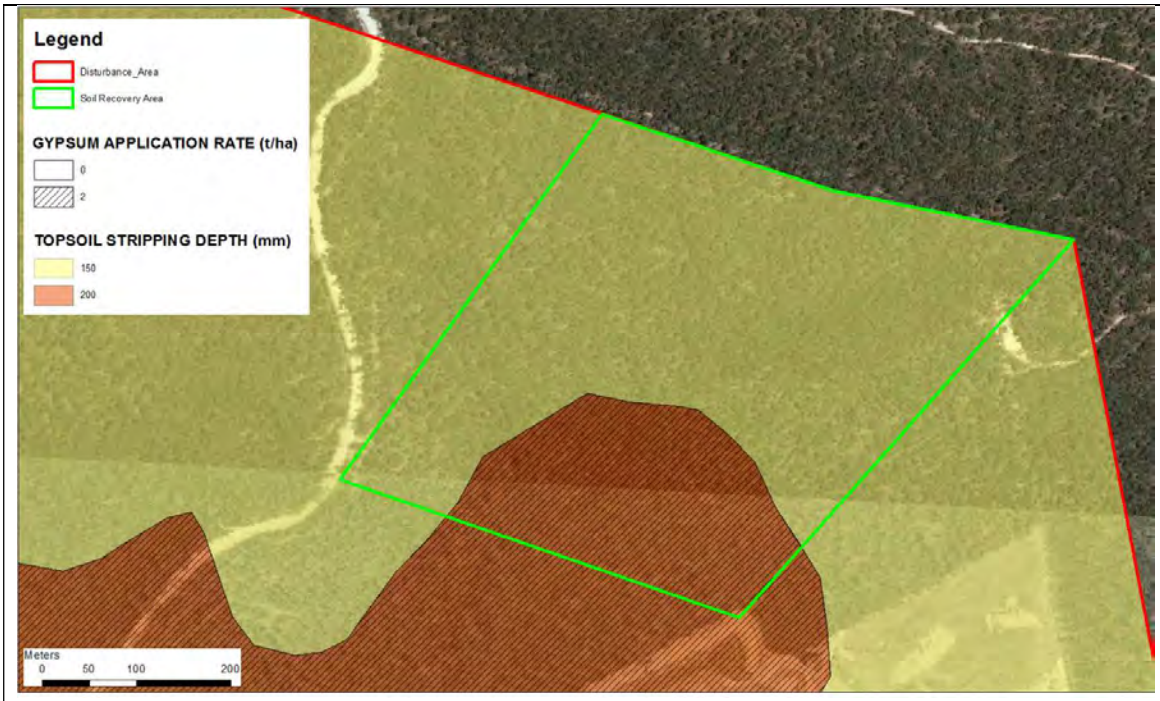
Soil Recovery Record

Table C1. Materials to recover.

Soil Landscape	Area (ha)	Stripping Depths (mm)	Stripping Volume (x 1000 m³)[1]	Gypsum rate (t/ha)	Rehabilitation Suitability
Leard	17	0.15	25.5	Nil	Topsoil
		0.15–0.40	42.5	2	Subsoil
Blue Vale Slopes	5	0.20	10	2	Topsoil[4]
		0.20-0.60	20	7	Subsoil

1. A bulking factor has not been applied.

Location	**North of Pit. June, 2018**
Area (ha)	22
Total Topsoil Volume	35,500 m³
Total Subsoil Volume	62,500 m³
Direct Return ***(Location and Volume)***	Rehabilitation Area 'RA18/2' Topsoil 17,750 m³ Subsoil 35,500 m³
Stockpile Location ***(Location and Volume)***	North-East Stockpile 'SP#4' Topsoil 17,750 m³ Subsoil 27,000 m³
Compliance with Table C1	Partial. Gypsum not applied to Blue vale Topsoil
Corrective Actions	Apply gypsum during soil preparation for rehabilitation
Nature and quantities of salvaged bush rocks and timber	45 White Box hollow trunks salvaged and stored adjacent to cleared area.
Notes	
Environmental Supervisor ***(Name, Date, Signature)***	Dan Martin, 1 June 2018
Earthworks Supervisor ***(Name, Date, Signature)***	Greg Jones, 1 June 2018
Attachments	Map 1. Topsoil Soil recovery North of Pit. June, 2018 Map 2. Subsoil Soil recovery North of Pit. June, 2018


Legend
Disturbance_Area
Soil Recovery Area
GYPSUM APPLICATION RATE (t/ha)
0
2
TOPSOIL STRIPPING DEPTH (mm)
150
200
Meters
0 50 100 200


Legend
Disturbance_Area
Soil Recovery Area
GYPSUM APPLICATION RATE (t/ha)
2
7
SUBSOIL STRIPING DEPTH (mm)
150-400
200-600
Meters
0 50 100 200

Rehabilitation Record

Location	**WEA Batter - Southern Face RA#18/2**
Total Area (ha)	7.4 ha
Target Revegetation	Domain A Grassy Woodland
Gradient	1H:6H
Spoil gypsum amelioration rate	10 t/ha
Spoil ripping Depth	0.5 m
Topsoil Placement ***(Depth, Volume)***	Thickness: 0.15m Volume: 11,100 m^3
Topsoil Source ***(Soil Landscape or Stockpile #)***	Direct placement from Leard Soil Landscape; and Stockpile SP#18/4
Subsoil Placement ***(Depth, Volume)***	Thickness: 0.3m Volume: 22,200 m^3
Subsoil Source ***(Soil Landscape or Stockpile #)***	Direct placement recovered from Leard Soil Landscape in Jan-18; and Stockpile SP#18/6
Topsoil/Subsoil Ripping Depth	0.5 m
Fertiliser	DAP at 100 kg/ha and coated urea at 100 kg/ha.
Seeding ***(Species, rate, supplier, and date)***	Nil - Natural recruitment
Tubestock ***(Species, rate, supplier, and date)***	Planting completed 1 June 2018. Tube stock supplied from Namoi Catchment Group. Planting rate 1000 stems/ha. Species list attached.
Sowing/Planting Date	June 2018
Notes	
Environmental Supervisor ***(Name, Date, Signature)***	Dan Martin, 1 June 2018
Earthworks Supervisor ***(Name, Date, Signature)***	Greg Jones, 1 June 2018
Attachments	Map Rehabilitation Area 18/2. Tubestock species list

Tube stock species planted

Alphitonia excelsa	Red Ash
Atalaya hemiglauca	Whitewood
Brachychiton populneus	Kurrajong
Callitris endlicheri	Black Cypress Pine
Callitris glaucophylla	White Cypress Pine
Corymbia trachyphloia	White Bloodwood
Ehretia membranifolia	Peach Bush
Eucalyptus albens	White Box
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus dealbata	Tumbledown Red Gum
Eucalyptus dwyeri	Dwyer's Red Gum
Eucalyptus fibrosa subsp. nubila Eucalyptus melanophloia	Silver-leaved Ironbark
Eucalyptus populnea	Bimble Box
Exocarpos cupressiformis	Native Cherry

Appendix I

Boggabri Coal – biodiversity corridor plan

Biodiversity Corridor Plan (BCP)

Boggabri Coal Pty Ltd

BOGGABRI COAL PTY LIMITED

ABN 77 122 087 398

386 Leard Forest Road
Boggabri NSW 2382

PO Box 12
Boggabri NSW 2382
Australia

Revision Control Chart

Revision	Details	Date	Author/Reviewer/Approver	Signed
00	Original	28 Feb 2012	Paul Rossington/Lukas Clews	
01	Revision A	11 April 2013	Author: Paul Rossington/Lukas Clews Parsons Brinckerhoff Technical Review by: Selga Harrington	
02	Revision B	30 April 2013	Author: Paul Rossington/Lukas Clews Parsons Brinckerhoff Technical Review by: Alex Cockerill	
03	Revision C	April 2013	Author: Paul Rossington/Lukas Clews Parsons Brinckerhoff Technical Review by: Alex Cockerill	
04	Revision D	September 2018	Author: Clementine Watson/Nathan Cooper WSP Technical Review by: Alex Cockerill	

Distribution Control

Controlled copies will be distributed to and retained by relevant personnel including key Boggabri Coal Pty Limited (BCOPL), agency and contractor representatives.

Uncontrolled Copies

Uncontrolled copies may be issued on the authority of the Boggabri Coal Environment Superintendent. Such copies will neither be numbered nor kept up to date.

Contents

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Glossary

Glossary	
APVMA	Australian Pesticides and Veterinarian Medicines Authority
BCP	BCP
BMP	Biodiversity Management Plan
CMA	Catchment Management Authority
CoA	Conditions of Approval
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
LGA	Local Government Area
LHPA	Livestock Health and Pest Authority
MNES	Matters of National Environmental Significance
MSDS	Material Safety Data Sheet
NIWAC	Northern Inland Weeds Advisory Committee
NSW	New South Wales
RHDV	Rabbit Haemorrhagic Disease Virus
OEH	NSW Office of Environment and Heritage
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
TSC Act	*Threatened Species Conservation Act 1995*
WoNS	Weed of National Significance

1. Introduction

1.1 Background

This Biodiversity Corridor Plan (BCP) has been developed for the Boggabri Coal Project (the Project) on behalf of Boggabri Coal Pty Limited (BCOPL), a wholly owned subsidiary of Idemitsu Australia Resources Pty Limited.

The BCP is designed to meet the requirements of condition 3 of the Department of Environment (DoE) conditions of approval (EPBC 2009/5256).

The BCP has been developed to support the Biodiversity Management Plan (BMP) (Parsons Brinckerhoff 2012) and will be attached as an appendix.

Management measures and procedures contained in the BCP provide a framework for managing biodiversity values within the biodiversity corridor described in the conditions of approval as:

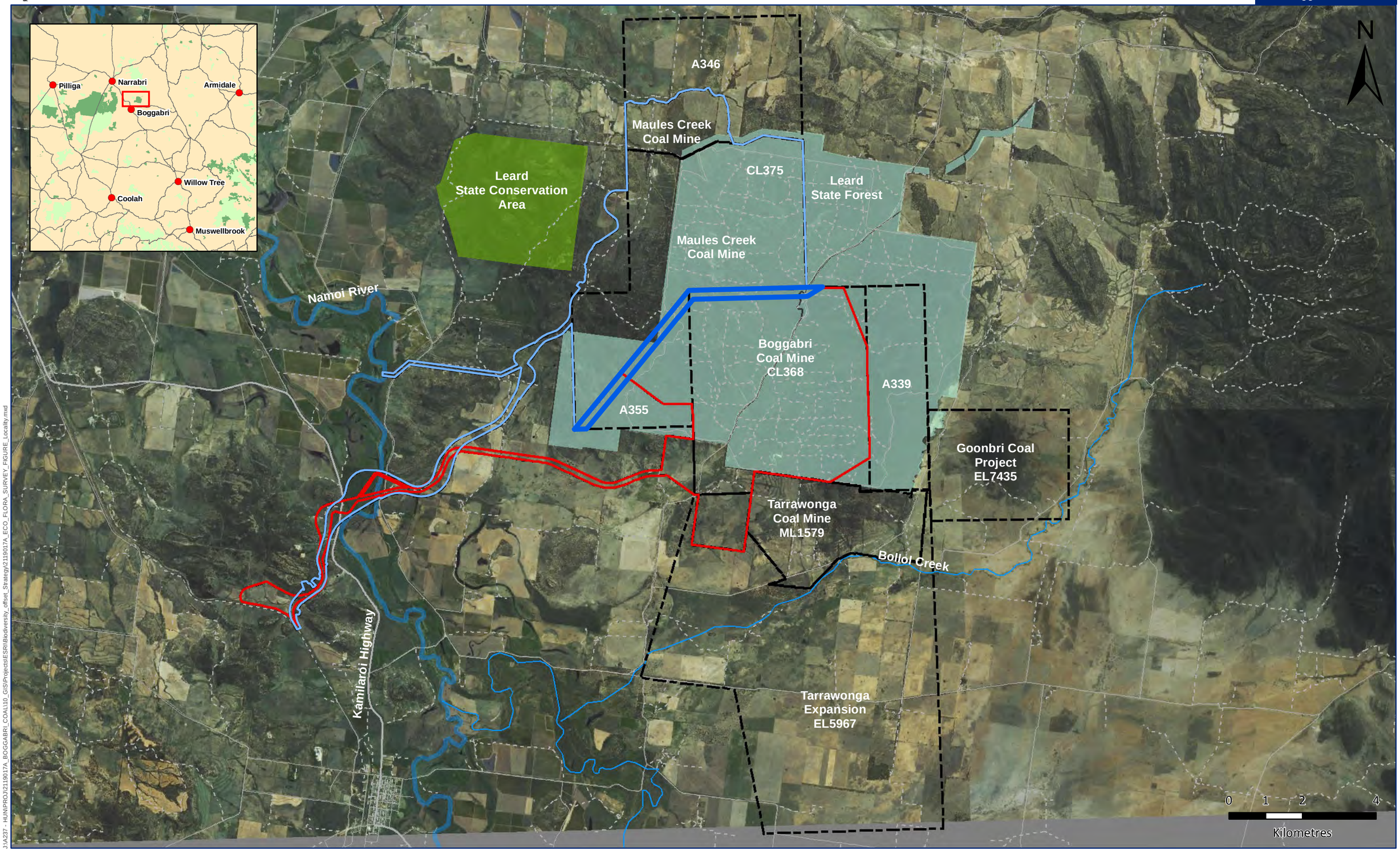
"…an area of native vegetation at least 250 m wide that has not been previously cleared for mining, which links the existing native vegetation to the east and west of the Maules Creek and Boggabri coal mine leases and is located within the Boggabri coal mine lease where it is adjacent to the Maules Creek coal mine lease boundary. The purpose is to ensure that a minimum 500 m wide native vegetation corridor is maintained between the Boggabri and Maules Creek mines and that any alternative corridor provides an equivalent or better ecosystem functionality (including habitat for the regent honeyeater, swift parrot and greater long-eared bat)" (Department of Sustainability Environment Water Population and Communities 2013).

The biodiversity corridor discussed in this plan is the 250 m wide section of the larger 500 m proposed corridor which spans the boundary between the Boggabri coal mine lease and the Maules Creek coal mine lease (refer Figure 1–1). It is henceforth referred to as the Boggabri-Maules Creek Corridor (or 'the corridor').

The BCP is focused on Matters of National Environmental Significance (MNES) and has been prepared based on ecological information available in the BMP (Parsons Brinckerhoff 2013) and information from the Environmental Assessment conducted for the Boggabri Coal Mine (Parsons Brinckerhoff 2010).

The BCP includes:

- a summary of the biodiversity values present in the corridor
- description of appropriate management measures for Matters of National Environmental Significance
- an annual monitoring program that can be incorporated with the monitoring that is currently outlined in the BMP.



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- Highway
- Road
- Track
- Biodiversity Corridor
- Project Boundary
- Maules Creek Project Boundary
- Boggabri Coal Mine Tenement

Figure 1-1 Locality Plan

1.2 Aim of this BCP

This BCP provides practical measures for managing and controlling the biodiversity associated with the Project as it relates to the Boggabri-Maules Creek Corridor. Specifically, this BCP aims to:

- provide details of the parties responsible for monitoring, reviewing, and implementing this BCP
- describe the measures (short, medium and long-term) to be implemented to manage remnant vegetation and habitat in the corridor including performance criteria
- describe the practical management strategies (including procedures) to be implemented to achieve the following objectives:
  - protecting vegetation and soil in the corridor
  - controlling weeds and feral animal species (minimising their introduction and spread)
  - controlling access
  - integrating management with adjoining land managers
  - minimising impacts to biodiversity, particularly threatened species
  - bushfire management
- provide a seasonally based biodiversity monitoring program to monitor and report on the effectiveness of the measures outlined in this BCP.

2. Biodiversity values in the corridor

The biodiversity values of the Boggabri-Maules Creek Corridor are summarised below.

2.1 Corridor location

A large portion of the land within the Boggabri-Maules Creek Corridor is located within Leard State Forest (refer Figure 1.1), which covers an area of 8,134 ha, the majority of which is natural vegetation.

The Leard State Forest was identified within Brigalow and Nandewar Community Conservation Area Agreement (BNC Agreement). This BNC Agreement incorporates multiple-use protected areas, designed to allow for improved conservation outcomes, while providing for the sustainable use of natural resources. The intent of the BNC Agreement is to provide:

- permanent conservation of land, their natural systems and biodiversity
- protection of areas of natural and cultural heritage significance to Aboriginal people
- continuation of forestry, exploration, mining, petroleum production and other uses in an ecologically sustainable manner within nominated zones
- strong involvement by local communities in the management of land zoned within the Community Conservation Area (CCA).

Within the CCA there are four dedicated management zones that have defined purposes allowing multiple uses (Table 2-1).

Table 2-1 BNC Agreement Management Zones

Zone	Project boundary
1	Zone 1 is reserved as national park under the NP&W Act for the purposes of conservation and recreation.
2	Zone 2 is reserved as Aboriginal Area under the NP&W Act for the purposes of conservation and Aboriginal culture.
3	Zone 3 is reserved as state conservation area under the NP&W Act for the purposes of conservation, recreation and exploration, mining and petroleum production.
4	Zone 4 is dedicated as State Forest under the *Forestry Act 1916* for the purposes of forestry, recreation and mineral extraction.

Leard State Forest was identified for management under Zone 4. This zone has been specifically set aside for forestry and mineral extraction.

Surrounding land uses include mineral extraction and rural activities, including pasture improvement, cropping and cattle grazing.

The Boggabri-Maules Creek Corridor is located on the northern and north-western boundaries of the Boggabri mining tenement within a large relatively intact patch of remnant vegetation surrounded by a landscape that has been modified significantly through anthropogenic disturbance associated with the above listed land uses.

2.2 Vegetation communities

The following seven distinct vegetation communities have been recorded in the corridor or extrapolated from surveys (Parsons Brinckerhoff 2010) of adjacent lands (refer Table 2–2 and Figure 2–1).

Table 2-2 Vegetation communities within the corridor

Vegetation community	Area (hectares)
Blue-leaved Ironbark heathy woodland	5.1
Dwyer's Red Gum woodland	5.0
Narrow-leaved Ironbark - Brown Bloodwood -White Cypress Pine shrubby open forest	1.3
Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	142.7
Native Olive dry gully forest	0.4
White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest	8.3
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest.	35.1

N

6612000.000000

6610000.000000

6608000.000000

Threatened Species and Communities

- *Pomaderris queenslandica*
- Barking Owl
- Black-chinned Honeyeater
- Black-necked Stork
- Diamond Firetail
- Eastern Bent-wing Bat
- Eastern Cave Bat
- Grey-crowned Babbler
- Hooded Robin
- Koala
- Large-eared Pied Bat
- Little Eagle
- Little Lorikeet
- Pale-headed Snake
- Speckled Warbler
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheathtail Bat

- *Pultenaea setulosa*
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC)
- Vegetation community distribution extrapolated from previous studies - not ground-truthed
- Biodiversity Corridor
- Mining Tenements

Vegetation Communities

- Blue-leaved Ironbark heathy woodland
- Derived native grassland
- Dwyer's Red Gum woodland
- Exotic grassland
- Narrow-leaved Ironbark - Brown Bloodwood - White Cypress Pine shrubby open forest
- Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- Native Olive dry gully forest
- Pilliga Box - Poplar Box - White Cypress Pine grassy open woodland
- White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest
- White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Box – White Cypress Pine grassy woodland
- Yellow Box - Blakely's Red Gum grassy woodland

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Kilometres

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IDEMITSU BOGGABRI COAL

Figure 2-1
Vegetation & threatened species recorded in the Boggabri-Maules Creek corridor

2.3 Threatened biodiversity

2.3.1 Threatened ecological communities

One ecological community listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and under the *Threatened Species Conservation Act 1995* (TSC Act) has been recorded within the corridor (refer Figure 2–1 and Table 2-3).

Table 2-3 Threatened ecological communities and corresponding vegetation communities within the corridor

Threatened ecological community	Corresponding vegetation community	Area (hectares)
EPBC Act		
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered	White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest	8.3
TSC Act		
White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Grassy Woodland)- Endangered	White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest	8.3

2.3.2 Threatened species

The purpose of this plan is the retention of a viable wildlife movement corridor for all native flora and fauna species in the locality. A focus on specific threatened species, populations and ecological communities (threatened biodiversity) affected by the project is also required to ensure that the corridor meets the needs of these groups. Threatened biodiversity affected by the project and of significance to the management of the corridor is listed in Table 2-4. The distribution of recorded threatened species is shown on Figure 2–1.

Table 2-4 Threatened species that are known or likely to occupy the corridor

Threatened species	TSC Act[1]	EPBC Act[2]
Plants		
Digitaria porrecta	E	E
Diuris tricolor		V
Pomaderris queenslandica	E	
Pultenaea setulosa		V
Animals		
Threatened woodland birds (Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella)	V	
Spotted Harrier	V	
Little Lorikeet	V	
Little Eagle	V	
Swift Parrot	E	E
Square-tailed Kite	V	

Threatened species	TSC Act[1]	EPBC Act[2]
Turquoise Parrot	V	
Barking Owl	V	
Masked Owl	V	
Superb Parrot	V	V
Regent Honeyeater	CE	EM
Threatened hollow-dependent microchiropteran bats (Eastern False Pipistrelle, Greater Long-eared Bat and Yellow-bellied Sheath-tail Bat)	V	V[3]
Threatened cave-dependent microchiropteran bats (Eastern Cave Bat, Eastern Bent-wing Bat, Large-eared Pied Bat and Little Pied Bat)	V	V[3]
Spotted-tailed Quoll	V	E
Squirrel Glider	V	
Koala	V	V
Border Thick-tailed Gecko	V	V

Notes: 1) TSC Act, V = Vulnerable, E = Endangered. 2) EPBC Act, CE = Critically Endangered, V = Vulnerable, E = Endangered, M = Migratory. 3) Greater Long-eared Bat and Large-eared Pied Bat only.

Of particular interest are the Regent Honeyeater, Swift Parrot and Greater Long-eared Bat which the condition of approval for the project identified as requiring habitat within the Boggabri-Maules Creek Corridor to maintain ecosystem functionality such as landscape scale movement opportunities between habitat areas. Of the EPBC Act listed species that are likely to be present, these species are considered most likely to use the habitats within the corridor.

Two species of bird, White-throated Needletail and Rainbow Bee-eater, recorded during field surveys are currently recognised under the migratory provisions of the EPBC Act. A further eight species have the potential to occur in the locality based on database searches. This includes, Great Egret, Cattle Egret, Latham's Snipe, Painted Snipe, White-bellied Sea-Eagle, Regent Honeyeater, Fork-tailed Swift and Malleefowl (Parsons Brinckerhoff 2010).

Under the EPBC Act, an action is likely to have a significant impact on a migratory species if it substantially modifies, destroys or isolates an area of important habitat for the species (Department of the Environment and Heritage 2006). For the migratory bird recorded or considered likely to occur, with the exception of the Regent Honeyeater, the Project area is not considered to comprise important habitat as it does not contain:

- habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat that is of critical importance to the species at particular life-cycle stages
- habitat used by a migratory species that is at the limit of the species' range
- habitat within an area where the species is declining (Department of the Environment and Heritage 2006).

The functionality of the corridor as movement habitat for the Regent Honeyeater is considered to encompass the movement requirements of these other migratory species.

3. Management safeguards for matters of national environmental significance

3.1 Procedures and strategies

Procedures and strategies have been developed for activities and processes that pose a significant risk to biodiversity. The Weed and Pest Management Strategy (Appendix B) forms part of this BCP.

3.2 Detailed management strategies

3.2.1 Integrating management with the Maules Creek Coal Project

Aim

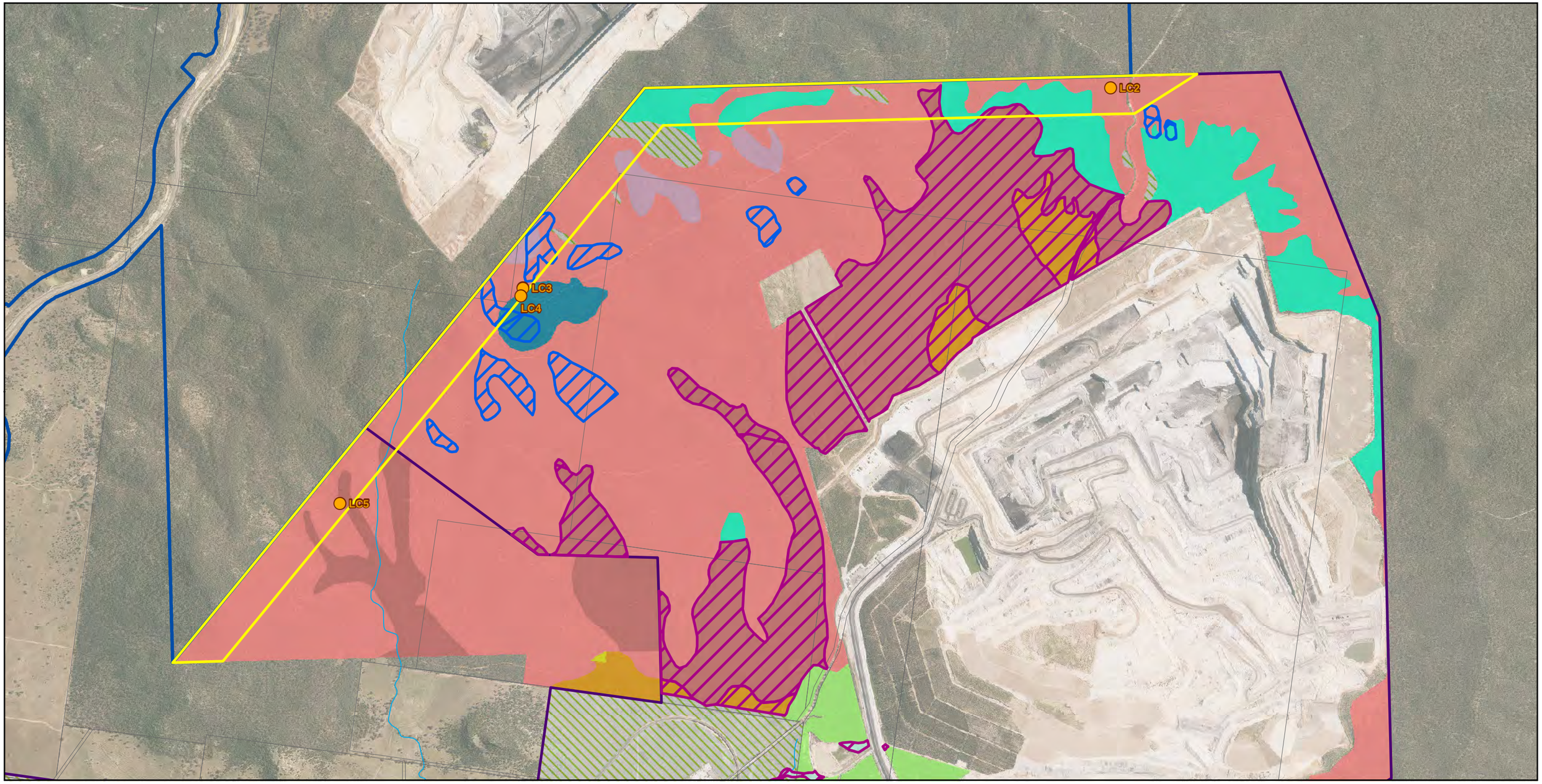
To coordinate management of the Boggabri-Maules Creek Corridor with that of the Maules Creek Coal Project section of the wider 500 m corridor (vegetated buffer) to ensure they are integrated or complementary.

Management strategies:

- consult representatives of the Maules Creek Coal Project regarding clearing limits to ensure an appropriate corridor is maintained
- consult on biodiversity management measures where applicable (e.g. weed and pest management, fire management) with representatives of the Maules Creek Coal Project
- hold meetings with representatives of the Maules Creek Coal Project to discuss common biodiversity management issues
- maintain a summary of consultation events
- undertake additional actions required by the Monitoring, Inspection and Reporting Program, as they relate to this objective.

Performance criteria:

- cooperation with representatives of the Maules Creek Coal Project is obtained on matters regarding biodiversity management (e.g. weed and pest species management)
- summary of records of consultation with the Maules Creek Coal Project are maintained and included in the Annual Environmental Monitoring Reports.



- Replicate survey site
- Boggabri-Maules Creek corridor
- Boggabri Project Approval Area
- Maules Creek Project Approval
- Threat-listed flora area
- Threat-listed ecological community

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range
- Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion
- Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion [PCT1380/NA163]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion
- Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion
- Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion
- Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1384/NA227]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion
- White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion
- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous
- Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

N
W E
S

0 0.5 kilometres

Scale 1:25,000

Projection: Transverse Mercator
Coordinate System: GDA 1994 MGA Zone 56
Scale correct when printed at A3 Landscape

Imagery:
BCPL (2018);

IDEMITSU BOGGABRI COAL

MINE NAME. 2171706A_GIS_BMP030_A1

AUTHOR. SuansriR

CHECKED BY. N.Cooper

DATE. 7/09/2018

FIGURE 4.1

TITLE. MANAGEMENT ACTIONS AND PROPOSED MONITORING LOCATIONS FOR THE BOGGABRI-MAULES CREEK CORRIDOR

DRAWING. \\corp.pbwan.net\ANZ\SectionData\Environment\EPSE\ECOLOGY\Z_boggabri\GIS\5_Shared_GIS\54_Production\Maps\Environment\BMP\2171706A_GIS_BMP030_A1.mxd

3.2.2 Controlling weeds and feral animal species

Aim

To manage weed and feral animal populations within the corridor to align with benchmark conditions observed in analogue sites.

Management strategies:

- observations of noxious weeds will be reported to the Boggabri Coal Environment Superintendent
- control noxious weeds in accordance with the actions set out in relation to the relevant weed control category or noxious weeds notice
- weed control methods designed to target specific species including physical and mechanical controls such as hand-pulling, chipping, and slashing and herbicide application; herbicide application will be used as a last resort to minimise the potential for off-target impacts on native biodiversity
- ensure that Project operations comply with the Weed and Pest Management Strategy (Appendix C of the BMP)
- monitor the progress of weed and pest controls annually as part of the Biodiversity Monitoring Program
- undertake additional actions identified as required by the Monitoring, Inspection and Reporting Program.

Performance criteria:

- weed and pest densities within the corridor and properties adjoining the Corridor boundary are monitored
- records of noxious weed observations, pest observations, treatment, and disposal are included in Annual Environmental Monitoring Reports
- the progress and effects of weed and pest management activities is monitored and reported annually as part of the Biodiversity Monitoring Program (refer Appendix A).

3.2.3 Bushfire management

Aim

To minimise the risk of inappropriate fire regimes which may adversely affect the biodiversity and functionality of the corridor. An overview of the management strategies and performance criteria is provided below.

Management strategies:

- monitor and maintain equipment and areas where bushfire hazards are present to prevent and minimise the potential outbreak of bushfire
- communicate issues relating to bushfire management at toolbox meetings

- ensure that all Project personnel report any environmental incident involving fire or flammable liquids to the site supervisor as soon as practically possible
- in the event of an accidental fire, implement the Incident Management Protocol
- if controlled burning is required, implement mosaic burning to reduce the extent of any negative outcomes, provide refuge for wildlife and promote structural and species diversity
- the timing of any burning will be determined based on fuel loads, vegetation maturity and weather/seasonal conditions; however it will generally be undertaken in autumn to encourage native species recruitment
- source relevant permits and approvals before any burning event
- monitor the effects of the fire regime in the corridor for effects on biodiversity (refer Section 5 for detail).

Performance criteria:

- accidental fires attributed to the Project occur are minimised
- no significant reduction in habitat suitability for fauna or alteration to the composition or structure of native plant communities occurs due to inappropriate fire regimes (refer Section 5 for detail of vegetation structure and habitat monitoring).

4. Monitoring, Inspection and Reporting Program

Compliance with this BCP in accordance with Project approvals, licences, permits and other legislative controls will be ensured by a program of inspections, monitoring and reporting. While the Environment Superintendent is responsible for managing this program, all Project personnel have responsibilities adhering to this BCP.

Monitoring of the corridor will be undertaken to assess the outcomes of management measures employed by Boggabri Coal and measure progress towards, and achievement of, performance criteria.

Monitoring within the corridor will involve vegetation and vertebrate methodologies, it will be undertaken annually (usually in spring) in conjunction with other biological monitoring programs associated with the project boundary. In addition, targeted seasonal monitoring techniques will be completed for Swift Parrot, Regent Honeyeater and Corben's Long-eared Bat. Monitoring methodologies are described in more detail below.

Data derived from the corridor monitoring sites will be compared with existing analogue sites established for the rehabilitation monitoring component of the BMP, and monitoring of biodiversity offset areas. Following the completion of baseline surveys, benchmark criteria for each vegetation community will be established. The benchmark data will be updated following each monitoring event.

Following baseline surveys, the general survey methodologies (Section 4.1.1) will be used to monitor the biodiversity corridor annually for five years up to and inclusive of the year 2022. From the year 2023, monitoring of the biodiversity corridor may be considered biennially. In accordance with the Project's EPBC Approval (EPBC 2009/5256), targeted surveys for Corben's Long-eared Bat, Swift Parrot and Regent Honeyeater (Section 4.1.2) are required annually in the biodiversity corridor.

Replicate monitoring sites (LSF1, LSF2, LSF3, LSF4) associated with annual monitoring of the operational impacts of the Project on Leard State Forest (refer to Section 7.1.1 of the main BMP)) will be used as analogue sites for comparative analysis.

4.1 Monitoring techniques

The sections below outline the survey techniques to be employed as part of the monitoring program within the biodiversity corridor. Four replicate survey sites have been established within the existing biodiversity corridor (Figure 4.1).

A summary of the survey methodologies required to be undertaken at each of these survey sites include:

- One BioBanking plot (described in detail in Section 4.1.1.1).
- Two 20-minute area searches within 80 m (approximately 2 ha) of fixed monitoring sites on separate mornings (described in Section 4.1.1.2)
- Two nights of passive Anabat detection (described in Section 4.1.1.2).

- Two consecutive nights of passive infra-red/ motion sensor camera detection (refer Section 4.1.1.2)
- Targeted threatened fauna monitoring (described in detail in Section 4.1.2)

4.1.1 General survey methodology

4.1.1.1 Flora survey

Flora monitoring will involve detailed quantitative site surveys in accordance with the *BioBanking Assessment Methodology* (Department of Environment Climate Change 2009) and photo point monitoring.

Details of the survey methodology is provided below in Table 4-1 and depicted in Figure 4-1.

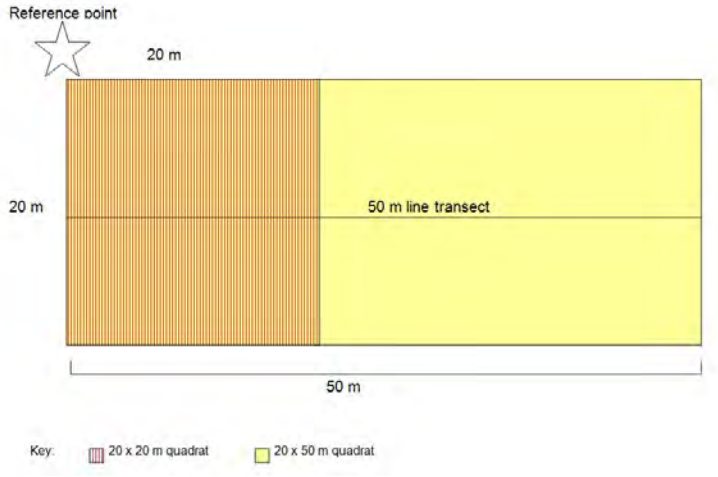


Figure 4-1 Schematic diagram illustrating the layout of the nested 20 x 50 m and 20 x 20 m quadrats used for the assessment of condition attributes at each site

Table 4-1 Variables to be measured during flora monitoring

Variable	Attribute	Plot or transect type	Description
Canopy	Species richness	20 x 20 m plot	A count of the total number of canopy species
	% canopy cover	Measured at 10 points along 50 m line transect (i.e. every 5 m)	An estimate of percent foliage cover for the canopy
	Number of trees with hollows	50 x 20 m plot	A count of the total number of living and dead trees with at least one hollow
	Regeneration	50 x 20 m plot	The proportion of canopy species regenerating (i.e. seedlings / saplings)
Midstorey	Species richness	20 x 20 m plot	A count of the total number of midstorey species

Variable	Attribute	Plot or transect type	Description
	% Midstorey cover	Measured at 10 points along 50 m line transect (i.e. every 5 m)	An estimate of percent foliage cover for the midstorey
Ground layer	Species richness	20 x 20 m plot	A count of the total number of ground cover species
	% native ground cover (grasses)	Measured at 50 points along a 50 m line transect (i.e. every 1 m)	Records of whether native grass intersects defined points along the transect to derive % cover.
	% native ground cover (shrubs)		Records of whether native shrubs intersects defined points along the transect to derive % cover.
	% native ground cover (other)		Records of whether native other (forbs, ferns, etc.) intersects defined points along the transect to derive % cover.
	Coarse woody debris (fallen logs)	50 x 20 m plot	Total number and combined length of all sections of dead fallen timber ≥ 10 cm diameter, ≥ 0.5 m in length, and completely detached from living or dead standing trees.
Weed species	Species richness	20 x 20 m plot	Total number of weed species.
	% cover	Measured at 50 points along a 50 m line transect (i.e. every 1 m)	An estimate of percent foliage cover for weed species in the canopy and midstorey. Records of whether ground cover weeds intersect defined points along the transect to derive % cover.
	Major weed infestations or invasion of native species	General observations	Record of species, location, size and density as required.
Groundcover	% cover of leaf litter, vegetation, bare ground, rock, cryptograms	5 1 x 1 m quadrats along either side of 50 m transect	An estimate of percent cover of groundcover attributes to determine groundcover composition
Disturbance	Clearing, cultivation (grazing and trampling), storm, flood or fire damage, soil erosion, firewood collection, salinity, feral herbivores.	Within and adjacent monitoring location.	Presence/absence of each attribute will be recorded.
Overall health and structure		Single photograph of 50 m transect	A single photograph taken from the start of the transect in the direction of the transect.

4.1.1.2 Vertebrate survey

Diurnal bird surveys – area search

The diversity and abundance of birds will be recorded from each replicate survey site using area searches (in similar habitat) within 80 m of the fixed monitoring sites. Designated surveys will be completed for 20 minutes during periods of high bird activity, predominately early morning or late afternoon, with birds identified to species level based on call recognition and/ or observation. Surveys will be completed at each sample site twice on separate days. Opportunistic records will also be collected during the entire survey period.

Microchiropteran bat surveys – ANABATS

Passive Ultrasonic Anabat Bat detection (Anabat SD1 CF Bat Detector – Titley Electronics, Ballina) will be used to record and identify the echolocation calls of microchiropteran bats foraging at each site. Passive monitoring of survey sites will be achieved by setting Anabat bat detectors to record throughout the night over two consecutive nights.

Bat call analysis to be undertaken using the guidelines of the Australasian Bat Society. Bat Calls of the Western Slopes and Plains (Pennay et al. 2004) will be used as a reference collection for bat call identification, as well as species specific reference calls collected in the project locality.

Infrared Cameras - Terrestrial mammals and pests

Passive infra-red motion sensor cameras would be positioned at each monitoring site to target terrestrial mammals and vertebrate pests. Passive monitoring will be achieved by arming camera traps to record continuously over two consecutive nights in conjunction with appropriate bait.

In addition to infra-red/ motion sensor cameras, observations of pest animals would be recorded opportunistically during any other biodiversity offset inspection. For significant pest animal occurrences or observed pest animal damage, the date, location, activity, density and pest animal species would be recorded and communicated to the Environmental Superintendent.

4.1.2 Targeted threatened fauna survey

The monitoring program will be focused on key indicator fauna species such as nectarivorous birds (e.g. honeyeaters, lorikeets) and microchiropteran bats. Particular interest is afforded to the Regent Honeyeater, Swift Parrot and Corben's Long-eared Bat, which are identified as requiring habitat within the biodiversity corridor to maintain ecosystem functionality such as landscape scale movement opportunities between habitat areas. In an attempt to quantify their use of the existing biodiversity corridor, targeted seasonal surveys for these species will be completed as detailed in Table 4.2. Monitoring will provide valuable information on the success of management measures as they depend on good quality habitats with complex structure for foraging, roosting and breeding habitat.

Details of targeted fauna surveys are provided in Table 4-2 and mapped in Figure 4-1.

Table 4-2 Variables to be measured during vertebrate monitoring

Target species	Methods	Effort	Frequency	Season
Regent Honeyeater	Targeted searches in suitable habitat[1]	1 day per season	Annually	Autumn/Winter[2]
Swift Parrot	Targeted searches in suitable habitat[1]	1 day per season	Annually	Autumn/Winter[2]
Corben's Long-eared Bat	Harp trapping[3]	8 trap nights over 2 nights[4]	Annually	Spring or Summer

Notes: 1) Targeting areas of heavily flowering eucalypts 2) Key foraging resources for Regent Honeyeater and Swift Parrot in the Boggabri locality is the winter flowering Eucalyptus albens (White Box). Therefore, as far as reasonably practicable, surveys will be undertaken annually to coincide with BirdLife Australia's National Regent Honeyeater and Swift Parrot Survey periods in May and August. 3) Corben's Long-eared Bat cannot be identified from echolocation call alone and trapping is required to confirm the presence of this species. 4) Depending on accessibility and efficacy of trap locations, some harp traps may be positioned in Leard State Forest adjacent to the biodiversity corridor.

5. Roles and responsibilities

Key management personnel and their relevant roles and responsibilities with regard to implementation of this BCP are detailed below in Table 5-1.

Table 5-1 Roles and responsibilities for implementation of the BCP

Role	Responsibility
BCOPL General Manager	Providing sufficient environment resources to ensure the effective implementation of the requirements of this plan.
BCOPL Mining Manager	Ensure the mining and biodiversity activities are undertaken in accordance with the commitments in this plan
BCOPL Environmental Superintendent	Liaising with regulatory authorities regarding BCOPL biodiversity management obligations as detailed in this plan Reviewing and updating this plan Ensuring all employees and contractors are aware of their environment management obligations in accordance with this plan Engaging specialist to undertake specific monitoring and environmental management activities in accordance with the commitments outlined in this plan Communicating the rehabilitation requirements outlined in this plan to all affected parties at BCOPL
Mining Contractor's Project Manager	Implementing biodiversity obligations in accordance this plan Developing and implementing specific procedures for the employees and subcontractors under their responsibility as required to facilitate compliance with this plan Ensuring all employees and subcontractors under their responsibility are aware of their environment management obligations Providing relevant environment data to assist BCOPL with environment reporting

5.1 Contact details

The names and contact details of key Project personnel are provided in Table 5-2.

Table 5-2 Site contacts

Title	Company	Contact No
General Manager Operations	BCOPL	02 67434775
Environment Superintendent	BCOPL	02 6743 4775
Operations Manager	BCOPL	02 6749 6006
24 Hour Community Response Line	BCOPL	1800 Boggabri

6. References

6.1 Internal References

The RMP forms a part of the BCOPL Environmental Management Strategy and the following documents should be referenced for further information relating to environmental management:

- BCOPL Biodiversity Management Plan
- BCOPL Cultural Heritage Management Plan
- BCOPL Rehabilitation Management Plan
- BCOPL Environmental Incident Response Management Plan.

6.2 External reference

Bell, LC 2001, 'Establishment of native ecosystems after mining — Australian experience across diverse biogeographic zones ', *Ecological Engineering*, vol. 17, no. 2-3, pp. 179-86.

Biosecurity SA 2011, *Weed Management Guide Weeds of National Significance: Opuntioid cacti, including Austrocylindropuntia, Cylindropuntia and Opuntia species*, Australian Goverment - Weeds Australia.

Department of Environment Climate Change 2009, *BioBanking Assessment Methodology and Credit Calculator Operational Manual*.

Department of Sustainability Environment Water Population and Communities 2013, *Approval Boggabri Coal Mine Extension (EPBC 2009/5256)*.

Department of the Environment and Heritage 2006, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*, Department of the Environment and Heritage, Canberra.

LesryK Environmental Consultants 2003, *Fauna biodiversity study of part of the Moorebank Defence Area: Site Development Options*, LesryK Environmental Consultants, Bundeena.

Parsons Brinckerhoff 2010, *Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment*, prepared for Hansen Bailey Pty Ltd Sydney.

Parsons Brinckerhoff 2012, *Biodiversity Management Plan - Boggabri Coal*, prepared for Idemitsu Boggabri Coal Newcastle.

Parsons Brinckerhoff 2013, *Biodiversity Management Plan - Boggabri Coal*, prepared for Idemitsu Boggabri Coal Newcastle.

Royal Botanic Gardens 2011, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, <http://plantnet.rbgsyd.nsw.gov.au/>.

URS 2004, *Flora Survey and Assessment for Moorebank Defence Site, Moorebank, NSW*, URS Australia Pty Ltd for GHD Group on behalf of Defence, Sydney.

Weeds of National Significance program 2008, *Weeds of national significance update 2008*.

Appendix A

Biodiversity corridor weed and pest management strategy

A1 Introduction

This Weed and Pest Management Strategy provides a framework for managing weeds and pests within the corridor. Specifically, this strategy aims to ensure that:

- weeds and pests are managed in accordance with relevant regulatory requirements and guidelines
- the introduction and spread of weed and pest species are monitored and controlled as required
- control measures are undertaken by trained and experienced personnel.

A2 Weed management

For the purposes of this strategy, a weed is defined as any plant species listed under the following:

- Noxious weed declarations under the Noxious Weeds Act 1993 for the Narrabri Shire Council control area.
- National Weeds Strategy – Weeds of National Significance (WoNS).
- National Weeds Strategy – National Environmental Alert List.

Seasonal surveys completed between December 2008 and September 2009 (Bell 2001) recorded 61 species of introduced flora within the Boggabri lease area. Of the introduced species recorded, nine are listed under the *Noxious Weeds Act 1993* for the Narrabri Shire Local Government Area (LGA) and four are classified as a WoNS (Weeds of National Significance program 2008) (Table A-1). Of these species, only the three *Opuntia* species have been recorded in the corridor, however, the other species may occur at low densities and may have potential to spread into the corridor flowing disturbance to adjacent lands.

No species listed on the National Environmental Alert List were recorded during the 2008-2009 surveys.

Table A–1 Weeds identified within the Boggabri lease area

Family	Scientific name	Common name	*Noxious Weeds Act 1993*	WoNS	National Environmental Alert List
Apiaceae	*Conium maculatum*	Hemlock	Class 4[1]	-	-
Asteraceae	*Xanthium spinosum*	Bathurst Burr	Class 4	-	-
Asteraceae	*Xanthium strumarium*	-	Class 4	-	-
Boraginaceae	*Heliotropium amplexicaule*	Blue Heliotrope	Class 4	-	-
Cactaceae	*Opuntia aurantiaca*	Tiger Pear	Class 4	Yes	-
Cactaceae	*Opuntia stricta*	Prickly Pear	Class 4	Yes	-
Cactaceae	*Opuntia tomentosa*	Velvet Tree Pear	Class 4	Yes	-
Chenopodiaceae	*Sclerolaena birchii*	Galvanized Burr	Class 4	-	-
Rosaceae	*Rubus ulmifolius*	Blackberry	Class 4	Yes	-

Note: Control class for noxious weeds under the Act.
Class 4 - Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area. Example control requirements: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

A2.1 Statutory requirements and guidelines

Legislation and information sources relevant to weed management within the biodiversity corridor are listed and summarised in Table B–2.

Table A–2 Legislative controls and information sources for weed management

Legislation/ information source	Notes	Reference
NSW Noxious Weeds Act 1993	Plants may be declared as noxious weeds under the *Noxious Weeds Act 1993* and are typically species that have potential to cause harm to the community and individuals and have the potential to spread within an area and to other areas. In NSW the administration of noxious weed control is the responsibility of the Minister for Primary Industries under the Act. The Act is implemented and enforced by the Local Control Authority for the area (Narrabri Shire Council) The Act imposes obligations on occupiers of land to control noxious weeds declared for their area.	http://www.austlii.edu.au/au/legis/nsw/consol_act/nwa1993182/
Pesticides Act 1999	This Act regulates and provides for the control and use of pesticides. Records should be kept of any pesticides used during the Project.	http://www.austlii.edu.au/au/legis/nsw/consol_act/pa1999120/
Pesticide Regulation 1999	This Regulation specifies training requirements for personnel handling and/or applying pesticides.	http://www.legislation.nsw.gov.au/sessionalview/sessional/sr/2009-417.pdf
Pesticide Permits and Registration	The use of herbicides during weed control will require registration permits which can be obtained online from the Australian Pesticides and Veterinarian Medicines Authority (APVMA) website. Weed control must only be undertaken with herbicides registered for treatment of each specific weed, and in accordance with manufacturer's directions.	http://www.apvma.gov.au/index.asp.
NSW *Threatened Species Conservation Act 1995* (TSC Act)	Under the TSC Act, restoration works (including weed management) will require a license where: ▪ the carrying out of bush regeneration activities (including weed removal and suppression) is undertaken in areas where an EEC currently exists ▪ bush regeneration activities are in close proximity to an EEC.	http://www.austlii.edu.au/au/legis/nsw/consol_act/tsca1995323/

Legislation/ information source	Notes	Reference
Narrabri Shire Council Weed Management Plans	The Narrabri Shire Council has developed management plans for 18 noxious weed species (including Blackberry, Blue Heliotrope, Hemlock and Prickly Pear).	http://narrabri.cfm.predelegation.com/index.cfm?page_id=1195
Northern Inland Weeds Advisory Committee (NIWAC) website	This website provides a resource for weed strategies, management plans and contacts within the NIWAC region.	http://www.niwac.org/
North West Weeds website	This website contains information regarding the identification and control of weeds in central NSW. Details of weed control contractors are also provided.	http://www.northwestweeds.nsw.gov.au/
The NSW Department of Trade &Investment (DT&I) Primary Industries weeds website	This website provides an overview of weed management in NSW. The status of weeds and control information is updated regularly.	http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
DT&I Primary Industries Primefacts	The Primary Industries division of DT&I produces a range of fact sheets for land management, including Primefacts. Fact sheets are available for a range of weed species and control measures.	http://www.dpi.nsw.gov.au/aboutus/resources/factsheets

A2.2 Management actions

All noxious weeds within the biodiversity corridor will be controlled in accordance with the requirements of the *Noxious Weeds Act 1993*. The implementation of the Monitoring, Inspection and Reporting Program will allow for monitoring and control. TThe introduction and spread of weed species will be minimised within the corridor by restricting access to areas of native vegetation and communicating the responsibilities of all Project personnel at site inductions and/or during regular toolbox meetings.

A2.3 Control methods for noxious weeds

Detailed methods and chemical application rates for the control of noxious weeds are provided in specific weed management plans prepared by Narrabri Shire Council or contained in the *Noxious and Environmental Weed Control Handbook* (Royal Botanic Gardens 2011). The control methods outlined in the chemical product label and data safety sheet are to be used for the application of weed control products. . Record-keeping and training requirements are dictated by the *Pesticides Act 1999*.

A2.4 Herbicide use protocol

Safety directions, first aid, storage and disposal, protection of non-targeted plants, protection of wildlife, fish, crustacea and the environment shall be as described by the manufacturer and detailed on the product label and Safety Data Sheet (SDS). Personnel or contractors using herbicides must carry the product label and SDS for all herbicides and related chemicals carried (including herbicide dyes and wetting agents). All personnel who use herbicides must be qualified.

Chemical treatment is to be carried out with regard to the following matters:

- the Environment Superintendent is responsible for ensuring that any chemical control activity undertaken for the Project complies with the *Pesticides Act 1999*,
- the use of herbicide is generally the most efficient means of controlling weeds on site, however other appropriate techniques of weed control will not be discounted (i.e. hand pulling seedlings in proximity to native plants)
- chemical use will be undertaken in accordance with product label and MSDS requirements
- different herbicides will not to be mixed or used contrary to the uses prescribed on the product label
- chemicals will be stored, transported or used in accordance with relevant label information and Australian Standards so as to ensure compliance with Environment Protection Legislation
- indicator dye will be used for all herbicide applications (neat applications and foliar spray)
- disposal of empty chemical containers will comply with label, MSDS, and local government requirements
- herbicide will be applied carefully to avoid damage to non-target species. If native species are growing close to target weed species they will be shielded from spray damage
- foliar spraying will not be undertaken during or preceding unsuitable weather conditions such as rain or wind that may cause spray drift
- following the use of pesticides, the Pesticide Application Record Sheet will be completed and provided to the Environment Superintendent (Table A-3).

Table A-3 Pesticide Application Record Sheet

Pesticide use information
Date and time:
Personnel applying pesticide:

Pesticide use information	
Treatment area coordinates	Easting: Northing: Datum:
Treatment area description:	
Target weed species:	
Equipment used:	
Chemical name, concentration and rate:	
Area covered by application:	
Wind speed and direction:	
Other weather details:	
Other notes:	

A3 Pest management

Seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010) recorded seven pest species including Common Starling, Fox, Brown Hare, Rabbit, Black Rat, Common House Mouse and Pig.

A3.1 Statutory requirements and guidelines

Legislation and information sources relevant to pest management within the biodiversity corridor are listed and summarised in Table B-1.

Table B–1 Legislative controls and information sources for pest management

Legislation/ information source	Note	Reference
Rural Lands Protection Act (1998)	Under the Act landholders are obligated to control feral pigs, wild dogs and wild rabbits through pest control orders. LHPAs are charged with enforcing the orders. The biodiversity corridor is located within the Central North LHPA region.	http://www.austlii.edu.au/au/legis/nsw/consol_act/rlpa1998256/
NSW Threat Abatement Plan for Predation by the Red Fox	This plan establishes priorities for fox control for the conservation of biodiversity across NSW. The plan is coordinated by OEH. In particular, the plan identifies which threatened species are most likely to be impacted by fox predation and the sites at which these impacts are predicted to be most critical.	http://www.environment.nsw.gov.au/threatenedspecies/RedFox-FinalThreatAbatementPlan.htm
Pesticides Act 1999	This Act regulates and provides for the control and use of pesticides. Pesticide Control Orders are required for the use of certain pesticides (e.g. 1080 fox bait).	http://www.austlii.edu.au/au/legis/nsw/consol_act/pa1999120/
Pesticide Regulation 1999	Specifies the training requirements for personnel handling and/or applying pesticides.	http://www.legislation.nsw.gov.au/sessionalview/sessional/sr/2009-417.pdf
Code of Practices and Standard Operating Procedures	Code of Practices and Standard Operating Procedures have been developed for a range of pest animal control methods. These documents are available on the SEWPAC and PestSmart website.	http://www.environment.gov.au/biodiversity/invasive/publications/humane-control.html http://www.pestsmart.org.au/
Central North Livestock Health and Pest Authority	The Central North LHPA website contains media releases relating to pest management and contact details of local staff.	http://www.lhpa.org.au/districts/centralnorth

Legislation/ information source	Note	Reference
DT&I Primary Industries pest animals website	This website provides an overview of pest management in NSW. Information regarding pest species and their management is updated regularly.	http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
OEH pest animals website	Similarly to the DTIRIS website, this website provides an overview of pest management in NSW.	http://www.environment.nsw.gov.au/pestsweeds/pestanimals.htm
DT&I Primary Industries Primefacts	Primefacts are available for a range of pest species and control measures.	http://www.dpi.nsw.gov.au/aboutus/resources/factsheets

A3.2 Management actions

Pest animals within the biodiversity corridor will be identified and controlled as part of the Monitoring, Inspection and Reporting Program. The potential for the introduction and spread of pest animals will be minimised by maintaining the waste management practices and appropriate control measures will be implemented following the identification of any pest infestations.

As with weed infestations, pest animals may be identified and reported by Project personnel.

A3.3 Control methods for declared pests

Pest control measures will be implemented to control any infestations in consultation with key stakeholders including the Central North LHPA, Narrabri Shire Council and adjoining land managers. Control strategies may include the destruction of burrows, shooting, trapping and baiting.

The Environment Superintendent is responsible for ensuring that any chemical control activity undertaken for the Project complies with the Pesticides Act 1999.

Pest control actions will be undertaken with reference to Code of Practices and Standard Operating Procedures found at the above web sites (refer to Table C-5):

Appendix J

Tylophora linearis translocation and propagation management plan

Contents

List of figures

List of photo

E1. Introduction

E1.1 *Tylophora linearis* project background

Tylophora linearis is a threatened species listed as Vulnerable under the BC Act and Endangered under the EPBC Act. The species is a slender twiner with narrow linear dark green leaves and clear sap which produces tiny purplish flowers in groups of 3-8 (Photo 1). The species is known to grow on sedimentary flat in dry scrub, open forest and dry woodlands in association with *Eucalyptus albens, Callitris glaucophylla, Callitris enlicheri, Eucalyptus fibrosa, Eucalyptus sideroxylen* and *Allocasuarina luehmannii* (Office of Environment and Heritage 2017).

Photo 1 *Tylophora linearis* in bud

Tylophora linearis was recorded at several locations within the Project Boundary in May to July 2014 during targeted surveys (Parsons Brinckerhoff 2014). The location of *Tylophora linearis* populations identified during the 2014 seasonal surveys are illustrated in Figure 1.

During the seasonal survey approximately 845 *Tylophora linearis* plants within 71 patches were observed within the proposed 2014 clearing area and therefore more are likely to occur within the remaining Project Boundary and Leard State Forest. Densities and numbers of plants varied with the greatest patch number recorded being 110 plants within a 6 m x 6 m area. The lowest density within a patch was represented by single plants. The species distribution and densities were patchy, with the highest numbers in areas where moisture may be more reliable in contexts such as south-facing slopes, slope toes, upper slope verges and where shrubs provide cover from wind while still transmitting sunlight.

Within the Project Boundary and Leard State Forest habitat for the species was identified as included the following:

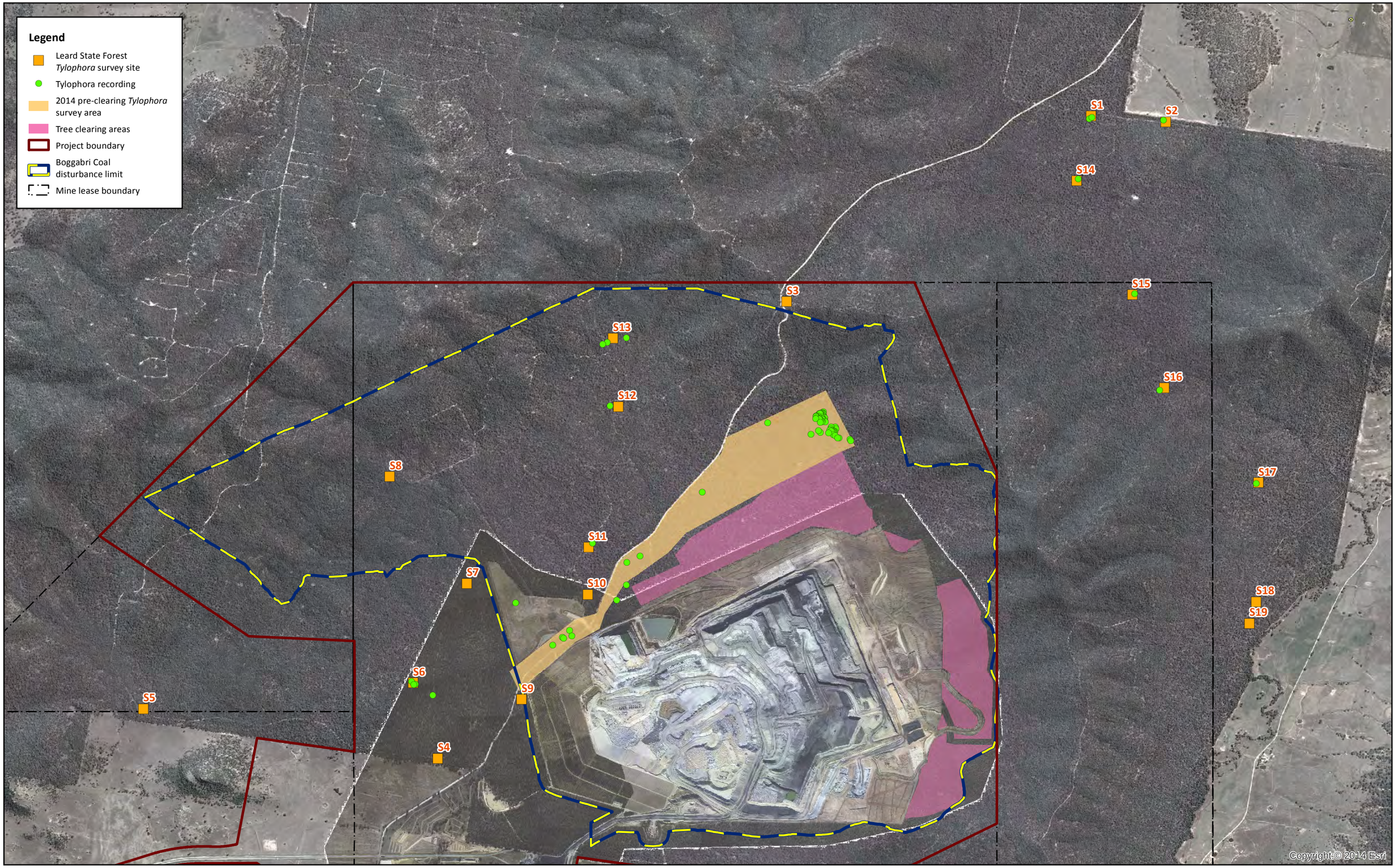
- The highest densities of plants were associated with *Eucalyptus crebra* (Narrow-leaved Ironbark) on loamy soils with *Cassinia laevis* in the understorey and a generally sparse ground-cover layer strewn with leaf litter. The area of greatest density was on elevated slopes between 5 and 10 degrees with a westerly to southerly aspect. A number of plant patches were showing red foliage and stems suggesting poor condition, possibly resulting from the effects of late winter frosts.

- Plants were also found where *Eucalyptus albens* (White Box) dominated upper slope habitat and most habitat contained *Callitris glaucophylla* (White Cypress Pine) as a co-dominant species. *Acacia decora* was also regularly present in the understory and plants were also associated with understorey shrub layers dominated by *Beyeria viscosa*, and in one instance, *Dodonaea viscosa*.

- No *Tylophora linearis* plants were observed in the south of the pre-clearing area, where Narrow-leaved Ironbark communities were associated with gravelly substrates and dominated by *Desmodium brachypodium*. However, where grassy box occurred on loamy substrates in an adjacent flat land area *Tylophora linearis* was found to be present.

The survey appeared to support a general demarcation in habitat occupancy between south-western facing slopes and open grassy woodlands in flatter contexts (Parsons Brinckerhoff 2014).

Photo 2 **White box shrubby woodland *Tylophora linearis* habitat within the Project Boundary**



Data Source:
Imagery from Boggabri Coal (Lidar September 2013) and Google Earth (acquired 09/12/2013)

Drawing No.: 2117317A_GIS_F096_A2

Date: 1/08/2014

Author: SuansriR

Reviewed:

0 125 250 500 750 1,000 M

Scale 1:30,000

Coordinate System: GCS GDA 1994

Scale correct when printed at A3 Landscape

Boggabri Mine

Figure 1

Targeted Survey Effort and *Tylophora linearis* locations

Idemitsu Boggabri Coal

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www.pb.com.au

E1.2 Purpose of this plan

This *Tylophora linearis* translocation and propagation management plan (henceforth referred to as the management plan) has been developed to meet Schedule 3, Condition 49 which was imposed on the project when the species was identified as occurring within the Project Boundary.

Schedule 3, Condition 49 states:

The Proponent shall prepare and implement a Biodiversity Management Plan for the project to the satisfaction of the Secretary. This plan must:…

> *xiv) Translocating and/or propogating the threatened flora species* Tylophora linearis *located within the project disturbance boundary – including details of methods and timing of propagation trials and programs and investigations into assisted natural regeneration in mine site rehabilitation and biodiversity offset areas.*

Whitehaven Coal has previously prepared a propagation and translocation program for the *Tylophora linearis* population within the north western portion of Leard State Forest for the Maules Creek Coal Mine (Whitehaven Coal Limited 2017). Given the lack of knowledge available regarding the species, proximity of the project to Maules Creek (i.e. potential for the Project's *Tylophora linearis* to form part of the Maules Creek population) and experimental nature of translocation this management plan has been prepared largely in reference to Whitehaven Coal's '*Tylophora linearis* propagation and translocation program' for consistency. Reference has also been made to the Australian Network for Plan Conservation's 'Guidelines for the Translocation of Threatened Plants in Australia' (Vallee *et al.* 2004) as well as other resources and studies available at the time of preparation.

E2. Translocation and propagation program

E2.1 Program stages

This management plan will be implemented in a staged approach consistent with Whitehaven Coal (2017) to optimise the likelihood of success in translocating and propagating *Tylophora linearis* within the Project Boundary. The success of each stage is reliant on each of the previous stage(s) and therefore each stage must be undertaken in sequence.

The stages proposed for the translocation and propagation program are as follows:

- Stage 1 – Root architecture, growth and general reproductive ecology study
- Stage 2 – Seed production monitoring
- Stage 3 – Seed collection and storage
- Stage 4 – Seed propagation; and
- Stage 5 – Translocation trials.

Each stage listed above is described in more detail in the following sections. It should be noted that given the experimental nature of translocation the implementation of this management should be treated accordingly. In doing so it is important that all stages of this program are documented thoroughly to enable success and aid in the future management of the species.

The following stages should only be conducted by an appropriately qualified person(s) with a NSW Scientific Licence which allows the following to be completed.

E2.1.1 Stage 1 – Root architecture, growth and general reproductive ecology study

Aim

There is limited knowledge regarding the species general ecological characteristics aside from field observations documented by Forster et al. (2004) and those made during targeted surveys within Leard State Forest and the Project Boundary (Parsons Brinckerhoff 2014). Forster et al. (2004) documented that the reproductive biology of the species is likely to driven by an underground rhizome from which an aerial stem emerges. The extent to which this rhizome participates in reproduction is unknown and therefore it is likely that the species is clonal with small groups comprised of a number of clones. As such prior to commencing the translocation program is it vital that the species reproductive biology and ecology be adequately understood in order to implement the appropriate propagation techniques to optimise success.

Furthermore, the species is considered to be a perennial whose populations are likely to fluctuate on a year to year basis in response to a number of environmental factors such as drought, fire and disturbance. In addition, it is also considered likely that the species does not produce a flower every year, as most in the Apocynaceae (NSW Scientific Committee 2008). The flowering cues are unknown however are considered to be related to rainfall (NSW Scientific Committee 2008) which was supported by observations of the species flowering in October/November 2016 following higher than average rainfall during the 2016 annual biodiversity monitoring of Leard State Forest (WSP | Parsons Brinkerhoff, 2016). It is also assumed that the species is pollinated by insects as is most common with other species in the Apocynaceae.

The main aim of the root architecture, growth and general reproductive ecology study is to document the species reproductive ecology by studying the underground root structures to determine whether the species is clonal or uses other reproductive strategies just as reseeding or resprouting. These results will enable an appropriate propagation technique to be implemented such as seed propagation or whole plant translocation.

Timing

The study will be undertaken during the 2019 tree clearing operations. During the pre-clearance surveys populations and individuals of *Tylophora linearis* will be identified and flagged. During stage 1 of the tree clearing operation an area containing a known population previously flagged will be excavated and investigated to determine the root architecture and growth structure.

Given the species has been observed to prefer and be more responsive to wet conditions and mild autumn/winter seasons and that the species appears to drop all vegetative material back to the root stock following late winter frosts (Parsons Brinckerhoff 2014) it might be possible that the species may not be identified during 2018 summer pre-clearing surveys. In this circumstance, targeted surveys for the species should be undertaken in the 2019 pre-clearing area during autumn to identify specimens to complete the root architecture, growth and general ecology study as described below.

Methodology

In order to collect consistent and comparable data with that collected during the Maules Creek *Tylophora linearis* the methodology will be consistent with that undertaken by Whitehaven Coal (2017).

Therefore, a minimum of 20 *Tylophora linearis* plants from within the 2018 clearing extent and the following data would be collected:

- Photographs of each Tylophora linearis individual and the root structure
- Document the general vegetative condition of the entire plant
- Number and length of stems
- Length and depth of roots; and
- Maturity of the plant (i.e. where reproductive material is present such as buds, flowers etc.).

E2.1.2 Stage 2 - Seed production monitoring

Aim

The aim of seed production monitoring stage is to monitor known populations of *Tylophora linearis* for the purpose of gaining knowledge as to when plants development flowers, fruit and set seed for the intention of future seed collection.

Timing

Tylophora linearis has been reported by Forster et al. (2004) to flower in November several weeks after at least 20 mm of rainfall has been received following a lengthy dry period. The species has since been observed flowering in October 2016 (WSP | Parsons Brinckerhoff) following rain after a lengthy dry period and in March, April and May 2014 by Niche (Whitehaven Coal 2017). As such, the *Tylophora linearis* seed production monitoring will commence in March 2019 and be undertaken fortnightly until flowering/fruiting has ended or until the end of May. The study will recommence in October and be undertaken fortnightly until flowering/fruiting as ended or until the end of November.

If seed is observed during the 2018 seed production monitoring Stage 3 of the program will be initiated. If seed is not identified, the seed collection activities will not occur in 2018 and the seed production monitoring program will be modified and/or re-implemented during 2019/20.

Methodology

Similar to Whitehaven Coal (2017) a minimum of 20 flowering *Tylophora linearis* plants, ten from within the 2020 clearing area and ten from outside the 2020 clearing area, will be selected. The plants selected will be located scattered widely across these areas so as to increase genetic variation as part of subsequent stages of seed collection and propagation.

Each of the 20 plants will be tagged and be given an appropriate number or identification code and monitored visually in situ for flower/fruit.

The following data will be collected for those plants bearing fruit:

- Photographs of the flowering section of each plant at each monitoring event
- Document the general vegetative condition of the entire plant during each monitoring event
- Count of total numbers of open/dead flowers on each plant during each monitoring event
- Date when each new fruit is observed on each plant
- Length and widest diameter of each fruit during each monitoring event; and
- Where multiple fruit develops on a single plant then each fruit will be tagged and coded.

The following data will be collected for those plants not bearing fruit:

- Count of the total number of open/dead flowers on each plant during each monitoring event; and
- Length and widest diameter of each fruit during each monitoring event.

E2.1.3 Stage 3 - Seed collection and storage

Aim

The aim of Stage 3 is the collection and storage of *Tylophora linearis* seed for propagation and storage with the BioBank Seed Field's Environmental Solutions and/or the Australian PlantBank.

Timing

Seed collection and storage will commence immediately following the identification of seed during the seed production monitoring (Stage 2).

Methodology

Similarly to Whitehaven Coal (2017), the procedure for collected *Tylophora linearis* seed is as follows:

1. When fruit are approximately 2 centimetres (cm) in length the fruit will be bagged with a bag of sufficiently sized to allow the fruit to develop inside the bag. Suitable bagging material could be made from nylon stockings fine enough to keep out pest insects whilst allowing air and light to flow through.
2. When fruit has open to shed seed, the fruit will be cut at the main stem. The fruit and bag will then be transferred to a paper bag with fresh silica gel.
3. The fruit and bag will be stored in a cool, dry and dark place; and

4. Once practicable, the fruit will be sent by priority mail to the BioBank Seed Field's Environmental Solutions and/or the Australian PlantBank.

BioBank Seed Field's Environmental Solutions is a professional seed collection, storage and propogation company specialising in large scale revegetation projects with over 20 years experience. The Australian PlantBank is a science and research institution of the Royal Botanic Gardens and Domain Trust located at Mount Annan Botanic Gardens. Collected seed will be stored and/or used by the BioBank Seed Field's Environmental Solutions and/or the Australian PlantBank as part of a propagation program.

E2.1.4 Stage 4 - Seed propagation

Aim

Should sufficient seed be collected during Stage 3 all or a selection of the *Tylophora linearis* seed collected will be propagated. The ex situ seedlings will be suitable for translocation as part of Stage 5 of the program.

Should a sufficient supply of *Tylophora linearis* seeds not be collected during Stage 3 of the program alternative propagation techniques will be considered to produce seedlings. One technique to be considered will be the production of seedlings via tissue culture which is a well-established technique that has been applied to another Tylophora species; *Tylophora indica* (Faisal et al. 2007). This technique enables the production of mass quantity for horticultural or native plant translocation purposes.

Timing

Should sufficient seed be collected this process will commence following Stage 3 or once sufficient plant material has been collected should sufficient seed not be collected.

Methodology

Seed propagation will be undertaken by an appropriate tissue culture laboratory or by the Australian PlantBank that will germinate the seed or utilise the collected plant material to germinate seedlings in sterile conditions.

E2.1.5 Stage 5 - Translocation trials

Aim

If sufficient *Tylophora linearis* seedlings are propagated in the previous stages a translocation proposal will be prepared in accordance with the Australian Network for Plant Conservation's 'Guidelines for the Translocation of Threatened Plants in Australia' Vallee et al. (2004). These guidelines are due to be revised in 2017/2018 and so the most recent will be used when preparing the translocation proposal.

Translocation could involve either the translocation of ex situ propagated *Tylophora linearis* seedlings or the relocation of in situ whole plants to be displaced/removed as part of the vegetation clearing process.

Timing

The *Tylophora linearis* translocation proposal will be developed once an ex situ supply of seedlings suitable for translocation have been propagated in accordance with the previous stages of the management plan.

Methodology

The translocation proposal will outline the procedure for which the translocation program will be undertaken. Given the experimental nature of translocation, the translocation proposal will detail the

translocation research trials required to identify potential methods for establishing the propagated *Tylophora linearis* seedlings and potential translocation locations pending the success of the previous stages outlined above.

Should sufficient seedlings be propagated in the previous stages, consideration will be given to translocating the ex situ seedlings cultured into appropriate habitats within the BOAs. If the collection and propagation of seed is unsuccessful, consideration will be given to the translocation of displaced/removed whole plants from within the clearing limits of the Project Boundary into the BOAs prior to clearing being undertaken.

The translocation proposal of *Tylophora linearis* ex situ seedlings of in situ whole plants will be prepared in accordance with the most current translocation guidelines (Vallee et al. 2004) and in consultation with Whitehaven Coal to determine the most appropriate species specific requirements to optimise success. As such the proposal will include:

- Personnel undertaking the translocation process
- Consultation to be undertaken or findings of consultation undertaken with Whitehaven Coal and other appropriate authorities regarding success/failures of previous attempt to translocate *Tylophora linearis*
- Number and location of proposed translocation sites (within the BOAs) as well as a discussion as to why each of the proposed sites are appropriate and not likely to impact on the existing natural environment
- Information on the number of individuals to be translocated at each site
- On-going management required
- On-going monitoring of translocation progress to measure success/failure and alternative management recommendations which may be required
- Potential risks and mitigation measures to be employed
- Competition criteria and
- Funding required to complete the process.

E3. Assisted natural regeneration

Assisted natural regeneration, often also referred to as 'bush regeneration', is the process by which humans are required to assist damaged native communitities of plants and animals to promote regeneration. The main aim of assisted natural regeneration is to create favourable conditions to enhance an ecosystems natural recovery processes.

Condition 49 (xiv) requires assisted natural variation of *Tylophora linearis* within the mine site rehabilitation and Biodiversity Offset Areas (BOAs).

To date, no *Tylophora linearis* have been recorded within the mine site rehabilitation areas. The species has however been recorded from one location within the Rocklea property which forms part of the Namoi BOA.

To provide assisted natural regeneration for *Tylophora linearis* an initial investigation will be undertaken to determine the species habitat preferences and any specific prosesses which may be threatening the species within these locations. This investigation would involve a review of:

- Vegetation mapping within the BOAs
- Rehabilitation and BOA annual ecological monitoring results
- Threatened species records of the species within the BOAs and Leard State Forest
- Root architecture, growth and general reproductive ecology investigation results undertaken as part Stage 1 of the *Tylophora linearis* 2019 tree clearing operations
- *Tylophora linearis* targeted survey report completed in May to July 2014 (Parsons Brinckerhoff 2014)
- Other relevant publications.

The findings of this investigation will identify and inform the appropriate approach to providing assisted natural regeneration for *Tylophora linearis* within the mine site rehabilitation area and BOAs. Key matters which will be determined will include:

- Identification of intact native vegetation which provide suitable conditions for the species which should be avoided so as to prevent disturbing or causing harm to the species
- Identification of and prioritisatrion of areas which require or would benefit from assisted natural regeneration
- Identification of key threats posing or with potneital to pose harm to the species and appropriate management to eliminate, prevent or manage these witihin the BOAs and mine site rehabilitation. For instance preventing spread or establishment of weeds within intact remnants of suitable habitat.
- Identification of areas which may contain favourable conditions for the species which could be used for translocation trials.

Based on the above appropriate natural assisted regeneration methods to be implemented would be determined in accordance with the Office of Environment and Heritage's Natural Regeneration Conservation Management Notes (Attachment A) and other appropriate assisted natural guidelines. These methods would be added to the BMP.

E4. Reporting

An annual report will be prepared documenting the implementation of this *Tylophora linearis* translocation and propagation management plan. Specifically, the annual report will provide an overview of the progress of each stage of the program and its trajectory towards success/completion. The report will be submitted annually as part of the Annual Review report to regulative authorities as required by the Project Approval conditions.

E5. References

Forster PI (1992) A taxonomic revision of Tylophora R.Br. (Asclepiadaceae: Marsdenieae) in Australia. Australian Systematic Botany 5, 29-51.

Office of Environment and Heritage 2017, *Threatened species, populations and communities database*, Office of Environment and Heritage,, <<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx>>.

Parsons Brinckerhoff 2014, 'Targeted *Tylophora linearis* search BCEP clearing area', vol. 2117272B-RES-MEM-Rev1.

Vallee, L, Hogbin, T, Monks, L, Makinson, B, Matthes, M & Rossetto, M 2004, *Guidelines for translocation of threatened plants in Australia*, Australian Network for Plant Conservation, Canberra.

Whitehaven Coal Limited 2017, *Maules Creek Coal Mine Biodiversity Management Plan*.

Attachment A

Natural regeneration

This note outlines ways of restoring degraded native vegetation by harnessing and promoting the regeneration processes that are built into native ecosystems.

Natural regeneration means allowing or assisting the bush to grow back by itself. It is the most effective and most economical way to expand patches of native vegetation and improve their condition.

Each site is different, and techniques and methods are tailored to suit the ecosystem being restored (e.g. grassland, rainforest, woodland, wetland etc), and the type of threats being managed.

In healthy bushland **natural regeneration** occurs with little help from people, such as after a bushfire or an ecological burn designed to replicate traditional fire regimes. When natural regeneration is actively promoted in degraded areas, it is referred to as **assisted natural regeneration** (bush regeneration or rainforest regeneration are types of assisted natural regeneration). Active promotion may include removing threats such as weeds or grazing, plus using triggers such as fire or soil disturbance. When planting or direct seeding is required, it is generally referred to as revegetation.

The aim of assisted natural regeneration is to create conditions that favour the ecosystem's own recovery processes. It is important to understand what is preventing recovery and how to fix these problems, or how to manage them if they can't be fixed. The table on page 2 gives an overview.

Angophora costata seedlings, naturally regenerating from seed-fall. Photo V Bear

Principles for assisting regeneration

Work where the natives are stronger. Don't start removing weeds in the worst areas, such as the weedy edges, because resilience is generally low and regeneration will be slow. Look after the good areas and create the conditions that promote their expansion into adjoining more degraded areas. An exception to the rule might be target weeds that are a particular threat, or protecting a high value asset such as an old paddock tree or a threatened species.

Match the area initially taken on, to the capacity for ongoing maintenance. Work in small manageable areas. It is best not to start works, such as intensive weeding, until it is certain that resources are available to see the project through. A common mistake is to kick-start the regeneration process, only to lose the new seedlings to competition from unexpectedly strong weed regrowth.

Avoid excessive disturbance because it often favours weed regrowth. But do employ some disturbance where it is needed to trigger native plant regeneration or to treat compacted soil — take a balanced approach to the degree of soil disturbance employed.

Avoid mulching (mostly) because mulch suppresses germination of seedlings, although it can be useful in areas of low or no resilience to control weeds and erosion, and improve soil condition. Small, low-resilience patches within a natural regeneration area could be mulched where natural leaf litter is available from nearby sources. Mulching can be useful on the edges of bushland areas to define the limits of grazing or mowing zones, and to suppress the encroachment of exotic grasses. Mulch should be free of weed seeds or propagules. Above all, avoid burying resilient areas under a layer of mulch.

What might be preventing natural regeneration, and what to do

Problem	Possible solutions
Grazing by livestock, macropods or feral animals.	Fence the area (see page 3) or use tree guards where practical. Reduce or strategically manage grazing. Control rabbits or goats.
Competition from weeds, including pasture species.	Remove weeds in a measured way and manage causes.
Soil compaction caused by trampling from stock or vehicles, or recreational use.	Manage the causes to prevent further damage. Provide habitat for soil fauna (e.g. allow leaf litter and fallen timber to accumulate), plant pioneer species such as wattles. Lightly rake or scarify — even rip in severe cases (but only if there are no weed sources nearby).
Lack of fire to trigger germination.	Use prescribed burning, smoke or smoke water treatment.
Frequent, low intensity fire.	Change management practices.
Lack of disturbance to trigger germination.	Lightly rake or scarify — rip in severe cases (but only if there are no weed sources nearby).
Loss of animals (e.g. bettongs and lyrebirds) that turn over soil and leaf litter, distribute soil fungi etc.	Improve habitat management on property and regional basis.
Loss of soil fauna (e.g. fungi, bacteria, worms and other invertebrates).	Provide habitat for soil fauna (e.g. allow leaf litter and fallen timber to accumulate). Reintroduce soil fauna by translocating small quantities of topsoil and leaf litter from nearby healthy areas.
Lack of seed dispersers such as birds and ants.	Improve habitat management on property and regional basis.
Lack of pollinators (e.g. insects, birds, mammals), leading to plants not setting seed.	Improve habitat management on property and regional basis.
Erosion — removing topsoil and seedbank, and damaging streambanks.	Reduce stocking rates. Place logs across soil surface to trap seeds and leaf litter, recontour the soil surface to trap seeds and leaf litter. Revegetate instead.
Elevated nutrient levels from fertiliser, animal faeces, or enriched runoff.	Prevent further nutrient enrichment, remove weeds and wait to see if natural regeneration occurs over time. Scalp off the contaminated topsoil, ensuring erosion will not occur, and revegetate. Revegetate.
Exposure to the elements (e.g. persistent strong winds, frosts, sunlight).	Plant a buffer on the windward side of a remnant bush patch, plant pioneer species. Focus regeneration efforts on areas which are more protected.
Excess shading from exotic species.	Remove or thin exotic trees and shrubs.
Drought .	Wait — sometimes natural regeneration does not occur for many years if intensive rainfall events are rare.
Lack of flooding.	Wait — it may be part of a long term natural cycle. On a regional basis, changes to water allocations may be required.
Mowing or slashing.	Change management practices.
Loss of resilience because of clearing, cultivation, frequent burning.	Reintroduce species after appropriate site preparation.
Salinity — conditions no longer suit local plants.	Revegetate instead using more salt tolerant species.
Erosion and siltation in watercourses.	Follow appropriate riparian conservation processes.

Fencing to assist regeneration

In rural areas, grazing is often the main factor inhibiting natural regeneration. Once remnant vegetation is fenced, grazing can be stopped or strategically managed, allowing natural regeneration to start again. The damaged areas can often recover with little or no further assistance.

Paddock trees protected from stock to allow for regeneration. Photo: OEH

The type of fencing will depend on:

- the length of time or season that grazing animals should be excluded
- the type of animals to be excluded
- the resources available.

Things to consider when fencing:

- fence an area bigger than the existing remnant to allow regeneration within and around the remnant
- make sure animals cannot reach over the fence to graze the vegetation (electric fencing is an economical way to exclude stock but allow the passage of native animals into the remnant — ensure the fence will not electrocute native animals such as echidnas)
- extend the fencing around and down-wind (i.e. in the opposite direction to the prevailing wind) of the remnant, if prevailing wind in the area is constant and strong.

A pattern of intense grazing for short periods followed by long rest periods is generally better for native vegetation than consistent grazing. Stock should be excluded when native species are flowering and seeding.

After an area is fenced, it is important to assess whether natural regeneration is occurring. The site should be monitored to see if new seedlings are coming up. It can take one to two years or longer because germination may need to be triggered by events such as drought breaking rains, flooding and fire. If no regeneration is taking place a regeneration trigger may need to be applied.

Controlling weeds in natural regeneration areas

Depending on its condition at the time of treatment, native vegetation often regenerates strongly once weeds are removed and more space and light is available. Weed control, however, is rarely a one-off event as weed seed is sure to be in the topsoil, and the factors that promote native plant regeneration tend to promote new weeds as well. After initial weed removal, follow-up work is required. Follow-up sessions may not take long but they need to be strategically timed (e.g. when weed regrowth is easiest to remove and has not seeded), and they may need to be continued for years, until the weed seedbank eventually diminishes. Care needs to be taken to minimise damage to regenerating native plants.

To choose the best weed control methods it helps to understand:

- the cause/s of the weed infestation — weeds are often a symptom of other problems
- which weeds are the greatest threat (e.g. vines that can potentially smother the canopy), and which weeds may not be much of a threat at all (e.g. small annuals)
- the nature of the weeds: their mature size, life-form (e.g. will they re-shoot from plant material left in the ground?), method of spread, life cycle (annual or perennial, when do they produce seed?)
- the approximate area affected by weeds, and the density of infestation
- whether there are native plants in, under or around the weeds
- whether the weed is playing a useful ecological role, such as providing habitat for native animals or protecting the creekbank from erosion (if so, removing them may cause more harm than good).

Some weeds — particularly spiky weeds with a dense form, such as lantana and African box-thorn — act as a refuge for native animals. Protecting habitat should be the top priority, so specialist advice may be needed before proceeding with weed removal. Replacement habitat may need to be established prior to removing these weeds.

Herbicides

Herbicide is a valuable weed management tool but needs to be used with great care in natural areas. Good plant identification skills are vital. It is important to choose a type of herbicide and application technique that will not harm surrounding native plants. This isn't always possible, and sometimes where there is a mix of native plants and weeds, hand weeding is actually a more efficient technique.

Herbicides are applied by foliar spraying, painting cut stumps, stem injection, basal bark spraying, and stem scraping.

A herbicide that becomes inert on contact with the soil, such as glyphosate, will minimise movement from one plant to another.

There are legal requirements for the use of herbicides. Information can be found at *www.environment.nsw.gov.au/pesticides/.* It is important to follow the instructions on the label, and stick to recommended doses for different weeds and techniques.

Revegetation — when regeneration is not enough

Where resilience is severely depleted or absent, plant material may need to be reintroduced. Some components of the native ecosystem may still have resilience (such as native grasses in pasture) but others (such as shrubs, or particular species) may have completely disappeared and require replanting or direct seeding.

Revegetation methods include:

- *tree, shrub and ground cover planting*
- *direct seeding by machine or hand*
- *brushmatting — cutting and laying seed-bearing branches*
- *direct transfer of topsoil with leaf litter from a healthy site (only if this does not damage the healthy site)*
- *transplanting seedlings and rootstock.*

Physical Control

For smaller weeds, pulling by hand or removing with hand tools is particularly efficient when there are light infestations and when weeds are growing among native plants. It is easiest after rain when the soil is softer.

Fire can be effective and is often also needed as a regeneration trigger (but can have heavy follow-up weeding requirements).

Seasonal crash grazing may be helpful in some circumstances. For instance if timed to reduce seeding of weeds but not affect natives.

Scalping and cultivation are not appropriate where natural regeneration is expected or there is a high risk of soil erosion, but can be highly effective for controlling nearby weed sources.

Biological Control

Some degree of biological control is available for a limited number of weed species, such as lantana, madeira vine and blackberry. Natural enemies, such as insects or diseases are used. Rather than eliminate a weed, they generally reduce it to a level where control can be achieved using other methods.

Useful references

Related Conservation Management Notes:

- Restoring native vegetation: regenerate or revegetate?
- Revegetation

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