



GOULBURN RIVER SOLAR FARM

Public Road and Culvert Upgrade Works
Biodiversity Development Assessment Report

FINAL

January 2024



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Biodiversity Development Assessment Report

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Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Lightsource bp

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QMS Certification Services

This report was prepared using
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Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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	Name	Date	Name	Date
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Executive Summary

Umwelt has been engaged by Lightsource Development Services Australia Pty Ltd (Lightsource bp), the Proponent, to prepare a Biodiversity Development Assessment Report (BDAR) to support the Environmental Impact Statement (EIS) for the proposed public road, intersection and culvert upgrade works (the proposed works) associated with the Goulburn River Solar Farm (the Project). A separate BDAR has been prepared for the Solar Farm component of the Project.

This BDAR has been prepared in accordance with the requirements of the Biodiversity Assessment Method (BAM) (DPIE 2020) and Section 6.12 of the NSW *Biodiversity Conservation Act 2016* (BC Act). This BDAR describes the biodiversity values of the Development Footprint and assesses the impacts of the proposed works.

This (amended) BDAR is an updated version of the BDAR submitted with the Project EIS in May 2023. Since lodgement of the EIS, Lightsource bp has conducted a thorough review of the layout and optimized the design to enhance Project efficiency while minimising associated environmental and social impacts. Project changes have occurred to address government agency and community submissions and to encompass the findings of the layout review and design optimisation process. This BDAR, alongside the amended Solar Farm BDAR, assesses the Amended Project and supports the Goulburn River Solar Farm Response to Submissions Report and Amendment Report.

The following works on public roads and culverts are required to support use by Project traffic:

- two culvert upgrades where Ringwood Road intersects with each of Bow River and Killoe Creek
- widening and resealing a 1.8 km length of Ringwood Road
- upgrade works to the Golden Highway and Ringwood Road intersection.

Consultation with the local community and Upper Hunter Shire Council has identified the opportunity to upgrade additional sections of Wollara Road and Ringwood Road as part of a community benefit. This includes sealing a 4.7 km section of Wollara Road which is currently unsealed, as well as re-sealing and widening an additional 1.6 kilometres (km) of Ringwood Road.

The works described in this BDAR cover approximately 13.17 ha and are divided into three distinct areas:

- Upgrades to the intersection of Ringwood Road and the Golden Highway (0.82 ha).
- Road widening and culvert replacement works on Ringwood Road starting at Bow River and extending south to Binks Road (5.43 ha).
- Road widening and sealing of Wollara Road from the existing sealed section to southern boundary of the Tongo State Forest (6.92 ha).

The proposed works do not include any road upgrades to the section of Wollara Road through the Goulburn River National Park and have included appropriate design measures to avoid and minimise impacts to biodiversity values.

The Development Footprint includes land within the Brigalow Belt South IBRA Bioregion - Liverpool Range IBRA Subregion and within the Sydney Basin IBRA Bioregion - Kerrabee IBRA Subregion. Accordingly, the following two separate Assessment Areas and BAM Calculator cases have been utilised, in compliance with the linear assessment requirements of Section 5.2.1 (7) the BAM:

- Liverpool Range IBRA Subregion Assessment Area.
- Kerrabee IBRA Subregion Assessment Area.

In April 2023, the Department of Planning and Environment updated the BAM Calculator to include the revised Plant Community Types (PCTs) in eastern NSW. The current classification was utilised for this assessment, noting that only the part of the Development Footprint within the Sydney Basin Bioregion is subject to the revised PCT classification.

The Development Footprint covers approximately 13.17 ha and is mostly composed of the existing cleared road surface. Five PCTs were recorded including:

- Liverpool Range IBRA Subregion Assessment Area.
 - 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley.
 - 1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter.
- Kerrabee IBRA Subregion Assessment Area.
 - 3334 Western Hunter Flats Red Gum Sedge Forest.
 - 3388 Central West Valleys White Box Forest.
 - 3781 Ulan Sandstone Ironbark-Pine Woodland.

PCT 1691, PCT 3388 and parts of the Scattered Trees Condition Zone for PCT 483 (in part) conform to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community (CEEC) listings under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the BC Act.

The PCTs observed that do not conform to any listed threatened ecological communities include PCTs 3334 and 3781.

The following ecosystem credit threatened fauna species were observed during the surveys completed:

- Hooded Robin (*Melanodryas cucullata*)
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Diamond Firetail (*Stagonopleura guttata*)
- Speckled Warbler (*Chthonicola sagittata*).

A species polygon and species credits are not required for the above ecosystem credit species and impacts on these species and their habitats will be offset through the retirement of ecosystem credits.

No threatened flora species or species credit threatened fauna species were identified within the Development Footprint. Mapped important habitat for the Regent honeyeater (*Anthochaera phrygia*) is present within the Development Footprint, however this species was not observed. The following threatened species, which are classed as species credit entities, have been assessed as assumed present as targeted surveys were not carried out due to limitations in survey timeframes and/or work safety considerations pertaining to the proximity of the Development Footprint to the existing road.

- *Commersonia rosea*
- Pine Donkey Orchid (*Diuris tricolor*)
- Large-eared Pied-bat (*Chalinolobus dwyeri*)
- Giant Burrowing Frog (*Heleioporus australiacus*)
- Pale-headed Snake (*Hoplocephalus bitorquatus*)
- Broad-headed Snake (*Hoplocephalus bungaroides*)
- Barking Owl (*Ninox connivens*)
- Common Planigale (*Planigale maculata*)
- Eastern Cave Bat (*Vespadelus troughtoni*).

Species polygons and species credits have been generated for offsetting impacts to these species credit entities.

Matters of National Environmental Significance (MNES) known or with potential to occur within the Development Footprint were assessed in accordance with the EPBC Act Significant Impact Guidelines and any applicable recovery plans or EPBC Act policy statements. The assessments undertaken have identified that no MNES are likely to be significantly impacted by the works.

An Aquatic Habitat Assessment is provided in **Appendix A** which describes the watercourses and key fish habitats present and provides an assessment of the likely impacts on listed aquatic threatened species, populations and ecological communities, listed under the NSW *Fisheries Management Act 1994* (FM Act). The assessment has determined that the proposal is not likely to have a significant effect on entities listed under the FM Act.

Following the application of impact avoidance, minimisation and management measures, the following impacts requiring biodiversity credits are documented in **Table ES.1** and **Table ES.2**.

Table ES.1 Ecosystem Credits Required

Vegetation Condition Zone	PCT No / PCT Name	Condition Class	BC Act	EPBC Act	Vegetation Integrity Score	Area (ha)	Credits Required
1	PCT 483: Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Scattered Trees	CE	CE (in parts: 0.16 ha)	86.1	0.2	11
2	PCT 483: Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley*	Exotic dominated grassland	Does not meet condition requirements	Does not meet condition requirements	9.9	3.12	0
3	PCT 1691: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Remnant Forest	CE	CE	67.9	0.09	4
4	PCT 3334: Western Hunter Flats Red Gum Sedge Forest	Remnant Forest	Not listed	Not listed	62.1	0.04	1
5	PCT 3388: Central West Valleys White Box Forest	Remnant Forest	CE	CE	51.8	0.36	12
6	3781: Ulan Sandstone Ironbark-Pine Woodland	Remnant Forest	Not listed	Not listed	81.1	1.05	32

* Assessed against benchmarks for PCT but too disturbed to be recognisable as part of the PCT.

Table ES.2 Species Credits Required

Species Name	BC Act	EPBC Act	Impact Area (ha)	Credits Required
<i>Commersonia rosea</i> *	E	E	0.36	14
Pine Donkey Orchid <i>Diuris tricolor</i> *	V	-	0.09	2
Regent Honeyeater <i>Anthochaera phrygia</i> [^]	CE	CE	0.16	9
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> *	V	E	1.54	85
Giant Burrowing Frog <i>Heleioporus australiacus</i> *	V	V	0.09	25
Pale-headed Snake <i>Hoplocephalus bitorquatus</i> *	E	E	0.09	3
Broad-headed Snake <i>Hoplocephalus bungaroides</i> *	E	E	1.05	64
Barking Owl <i>Ninox connivens</i> *	V	-	0.31	13
Common Planigale <i>Planigale maculata</i> *	V	-	0.09	3
Eastern Cave Bat <i>Vespadelus troughtoni</i> *	V	-	0.36	14

* Species assessed via assumed presence, ^ Species assessed via mapped important habitat.

The Project will impact the candidate serious and irreversible impact entity (SAII), White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community (0.65 ha). This TEC is at risk of an SAII due to:

- **Principle 1:** It will cause a further decline of the ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline; and
- **Principle 2:** It will further reduce the population size of the ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.

The works will impact a 0.16 ha of mapped important habitat for the Regent Honeyeater (*Anthochaera phrygia*). This species is listed as at risk of an SAII due to:

- **Principle 1:** It will cause a further decline of the species that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline; and
- **Principle 2:** It will further reduce the population size of the species that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.

This assessment has also assumed presence for the following threatened species listed as at risk of an SAI:

- *Commersonia rosea*. This species has not been recorded within the Development Footprint; and no individuals are expected to occur within the Development Footprint.
- Large-eared Pied-bat (*Chalinolobus dwyeri*). Whilst this species has not been recorded within the Project Area, 1.54 ha of potential foraging habitat and 0.01 ha of habitat within 100 m of potential breeding habitat will be impacted by the Project.
- Broad-headed Snake (*Hoplocephalus bungaroides*). This species is not known to occur in the Development Footprint, however there is 1.05 ha of an associated PCT within the Development Footprint.
- Eastern Cave Bat (*Vespadelus troughtoni*). Whilst not recorded in the Development Footprint, the total loss of potential habitat is 0.36 ha, including 0.01 of habitat within 100 m of potential breeding habitat.

For the threatened fauna species listed above, it is only impacts to breeding habitat which are considered to be a potential SAI due to:

- **Principle 4:** The impacted species is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

The Proponent has, where practicable, altered the Project to avoid and minimise ecological impacts and a range of impact mitigation strategies have been included to mitigate the impact on ecological values prior to the consideration of offsetting requirements. The residual impact of the Project requires a total of 60 ecosystem credits and 232 species credits. The Proponent is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project, with a focus on offsetting impacts where possible through a Biodiversity Stewardship Agreement established over the residual parts of the Solar Farm property.

Declarations

Certification under clause 6.15 *Biodiversity Conservation Act 2016*.

I certify that this report has been prepared by Umwelt (Australia) Pty Ltd and to the best of my knowledge it is based on the requirements of, and information provided under, the Biodiversity Assessment Method (2020) and clause 6.15 of the *Biodiversity Conservation Act 2016*.

Name: Jacob Manners

Signature:

A handwritten signature in black ink, appearing to read 'Jacob Manners', enclosed within a hand-drawn oval.

Date: 23 January 2023

BAM Assessor Accreditation no: BAAS17099

Glossary

Term / Abbreviation	Definition
Assessment Area	Includes the Development Footprint and the area of land within the 1500 m buffer zone surrounding the Development Footprint (or 500 m buffer zone for linear proposals) that is determined as per Subsection 3.1.2 of the BAM.
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BCD	Biodiversity and Conservation Division of NSW Department of Planning and Environment
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offsets Scheme
CEEC	critically endangered ecological community
CEMP	Construction Environmental Management Plan
CST	NSW Credit Supply Taskforce
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment, and Water
Development Footprint	The area(s) of land that is directly impacted by a proposed development
DBH	diameter at breast height over bark
DNG	Derived native grassland
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry, and Environment (superseded)
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GIS	Geographic Information System
GPS	Global Positioning System
HTW	high threat weed
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometres

Term / Abbreviation	Definition
LGA	Local Government Area
Lightsource bp	Lightsource Development Services Australia Pty Ltd
LLS Act	<i>Local Land Services Act 2013 (NSW)</i>
m	metres
mm	millimetres
MNES	Matters of National Environmental Significance
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
NSW	New South Wales
NVR Map	Native Vegetation Regulatory Map
OEH	NSW Office of Environment and Heritage (superseded)
PCT	plant community type
PMST	Protected Matters Search Tool
Project Area	The full width of the road corridor including the gap between the Development Footprint
SAIL	serious and irreversible impact
SAT	Spot Assessment Technique
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TEC	threatened ecological community
The Project	The proposed Goulburn River Solar Farm. The Project includes the construction, operation and decommissioning of a solar farm with capacity of up to 550 MW, a 280 MWp and 570 MWh BESS, associated infrastructure and road upgrades.
VEC	vulnerable ecological community
VIS	Vegetation Information System (a component of the NSW BioNet Atlas)
WM Act	<i>Water Management Act 2000 (NSW)</i>

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1.0 Introduction

1.1 Overview

Umwelt has been engaged by Lightsource Development Services Australia Pty Ltd (Lightsource bp), the Proponent, to prepare a Revised Biodiversity Development Assessment Report (BDAR) as part of the response to submissions and to assess amendments associated with the proposed public road, intersection and culvert upgrade works (the proposed works) associated with the Goulburn River Solar Farm (the Project). The Project is a State Significant Development (SSD) under Division 4.7 of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Goulburn River Solar Farm and the associated public road upgrade works are all located within the Upper Hunter Local Government Area (LGA) of New South Wales (NSW).

This report has been prepared in accordance with the requirements of the Biodiversity Assessment Method (BAM) (NSW DPIE 2020a) and Section 6.12 of the NSW *Biodiversity Conservation Act 2016* (BC Act). This report describes the biodiversity values of the Development Footprint and assesses the impacts of the proposed works.

The Project requires approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and has been declared a controlled action. The BAM has been endorsed as the assessment method for Matters of National Environmental Significance (MNES) under a Bilateral Agreement made under the EPBC Act. The Australian Government is the decision-maker for whether the Project will be approved under the EPBC Act. Nationally-listed threatened species, threatened ecological communities (TECs) and migratory species have been considered and assessed as part of this BDAR.

This (revised) BDAR is an updated version of the BDAR submitted with the Project Environmental Impact Statement (EIS) in May 2023. Since lodgement of the EIS, Lightsource bp has conducted a thorough review of the layout and optimised the design to enhance Project efficiency while minimizing associated environmental and social impacts. Project changes have occurred to address government agency and community submissions and to encompass the findings of the layout review and design optimisation process. This BDAR, alongside the Solar Farm BDAR, assesses the Amended Project and supports the Goulburn River Solar Farm Response to Submissions Report and Amendment Report.

1.2 Proposed Development

1.2.1 Development Overview

The proposed works assessed within this Report cover approximately 13.17 ha and include the following three separate areas, being:

- upgrades to the intersection of the Golden Highway and Ringwood Road (0.82 ha)
- road and culvert upgrades on Ringwood Road between Bow River and Binks Road (5.43 ha)
- sealing of Wollara Road to the southern boundary of the Tongo State Forest (6.92).

The proposed works do not include any road upgrades to the section of Wollara Road through the Goulburn River National Park.

The intersection and culvert upgrades are required to support use by Project traffic during construction, as is the upgrade to a 1.8 km length of Ringwood Road. The remainder of the proposed works (sealing a 4.7 km section of Wollara Road which is currently unsealed as well as re-sealing and widening an additional 1.6 km of Ringwood Road) are part of a project community benefit, identified through consultation with Upper Hunter Shire Council and the local community.

1.2.2 Location and Subject Land Description

The locations of the road upgrade works assessed within this report are shown on the Site Maps provided as **Figure 1.1A–Figure 1.1D** and **Figure 1.2A–Figure 1.2B** and the Location Maps, provided as **Figure 1.3A–Figure 1.3D** and **Figure 1.4A–Figure 1.4B**. The Development Footprint shown is the subject land boundary, the construction footprint and the operational footprint for the purposes of this assessment.

The proposed road upgrade works assessed in this report are located at three locations and are split across two BAM Assessment Areas (based on Interim Biogeographic Regionalisation for Australia (IBRA) Subregions) within the suburb of Merriwa, which is part of the Upper Hunter LGA of NSW. The Development Footprints and associated IBRA Subregion-based Assessment Areas are:

- Liverpool Range IBRA Subregion Assessment Area which includes:
 - The intersection of the Golden Highway and Ringwood Road (Golden Highway Intersection Upgrade Development Footprint).
 - Ringwood Road between Bow River and Binks Road (Bow River to Binks Road Upgrade Development Footprint).
 - The northern part of the upgrade to the unsealed section of Wollara Road from the southern boundary of the Tongo State Forest extending approximately 4.7 km to the north-west toward the Golden Highway (Wollara Road Upgrade Development Footprint).
- Kerrabee IBRA Subregion Assessment Area:
 - The southern part of the upgrade to the unsealed section of Wollara Road from the southern boundary of the Tongo State Forest extending approximately 4.7 km to the north-west toward the Golden Highway (Wollara Road Upgrade Development Footprint). This excludes the northern part assessed under the Liverpool Range IBRA Subregion.

1.2.3 Proposed Development Description

The proposed public road works include:

- **Golden Highway Intersection Upgrade Development Footprint** – Upgrades to the intersection of the Golden Highway and Ringwood Road, including pruning and removal of vegetation and trees, installation of a 325 m acceleration lane, embankment shaping and formalisation of the informal bus stop on Ringwood Road.

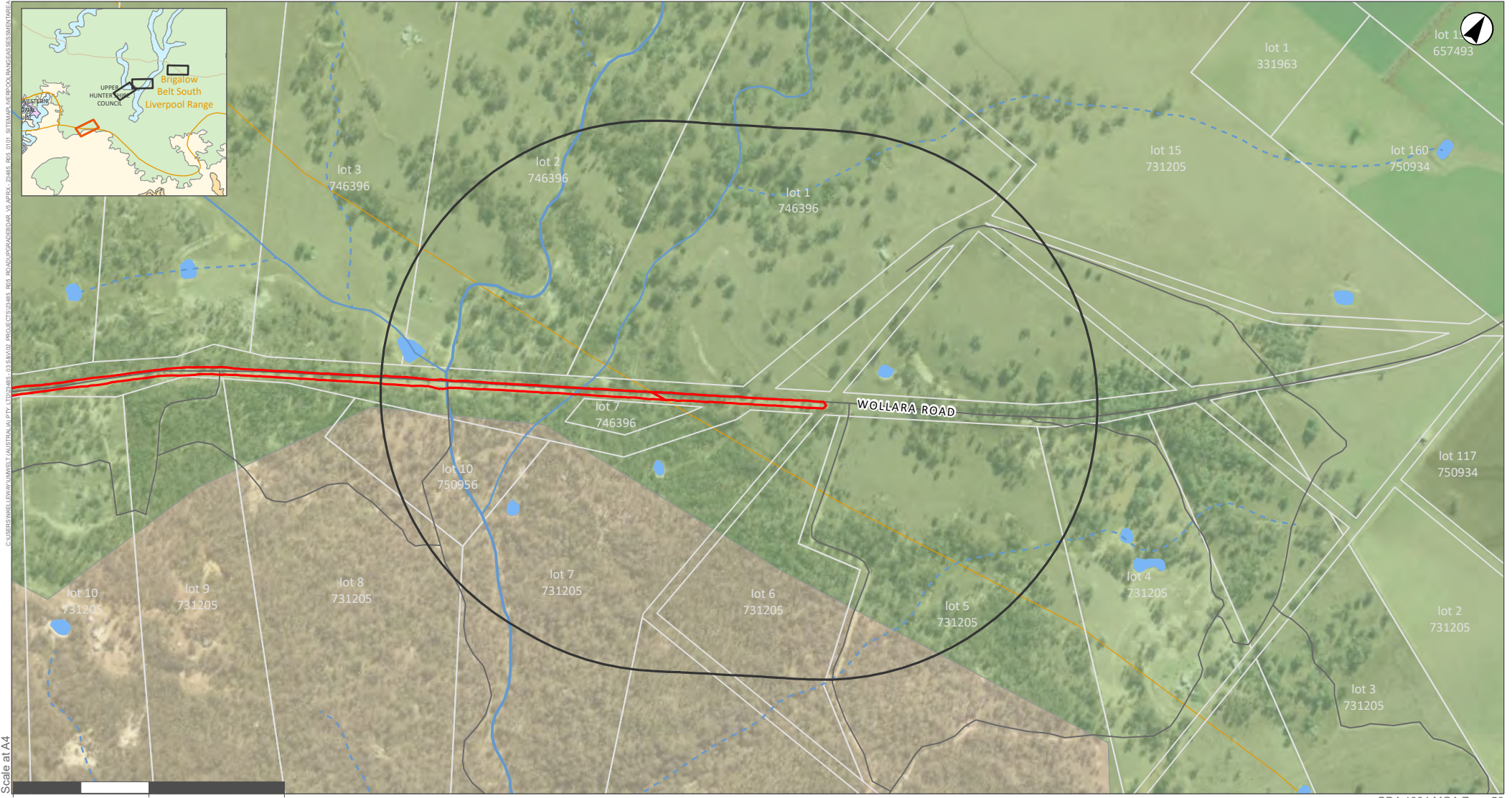
- **Bow River to Binks Road Upgrade Development Footprint** – Approximately 4.4 km of upgrades across two sections on Ringwood Road from Bow River to Binks Road, including realignment, widening and culvert upgrades at Killoe Creek and the Bow River.
- **Wollara Road Upgrade Development Footprint** – Approximately 4.7 km of road widening and sealing of the unsealed section of Wollara Road from the southern boundary of the Tongo State Forest extending to the north-west toward the Golden Highway.

The locations of the proposed works are mapped in **Figure 1.5** for the Golden Highway Intersection Upgrade Development Footprint, **Figure 1.6** for the Bow River to Binks Road Upgrade Development Footprint and **Figure 1.7** for the Wollara Road Upgrade Development Footprint.

Culvert upgrades will occur at two locations where Ringwood Road intersects the Bow River and Killoe Creek. The culvert upgrades will include:

- Installing larger culverts designed to accommodate two-way heavy vehicles, including B doubles and various farm machinery.
- Culvert width 7 m (3.5 m lane width) sealed carriageway with suitable guardrail and signage and associated drainage works.
- Stockpile site to be located on disturbed land within the road reserve in consultation with Upper Hunter Shire Council.
- Temporary side track at both locations to facilitate access during construction.
- All works are contained to the road reserve including any temporary access, stockpiling or compounds.

In total, approximately 8.1 km of road will be widened and resealed. These repairs will include 8 metre (m) bitumen-sealed formation with a minimum of 500 millimetre (mm) unsealed shoulders. The works aim to ensure that the horizontal and vertical alignment of the proposed road will ensure safe sight distance, safe movement of longer vehicles, and an improved road network for the users.



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Scale at A4

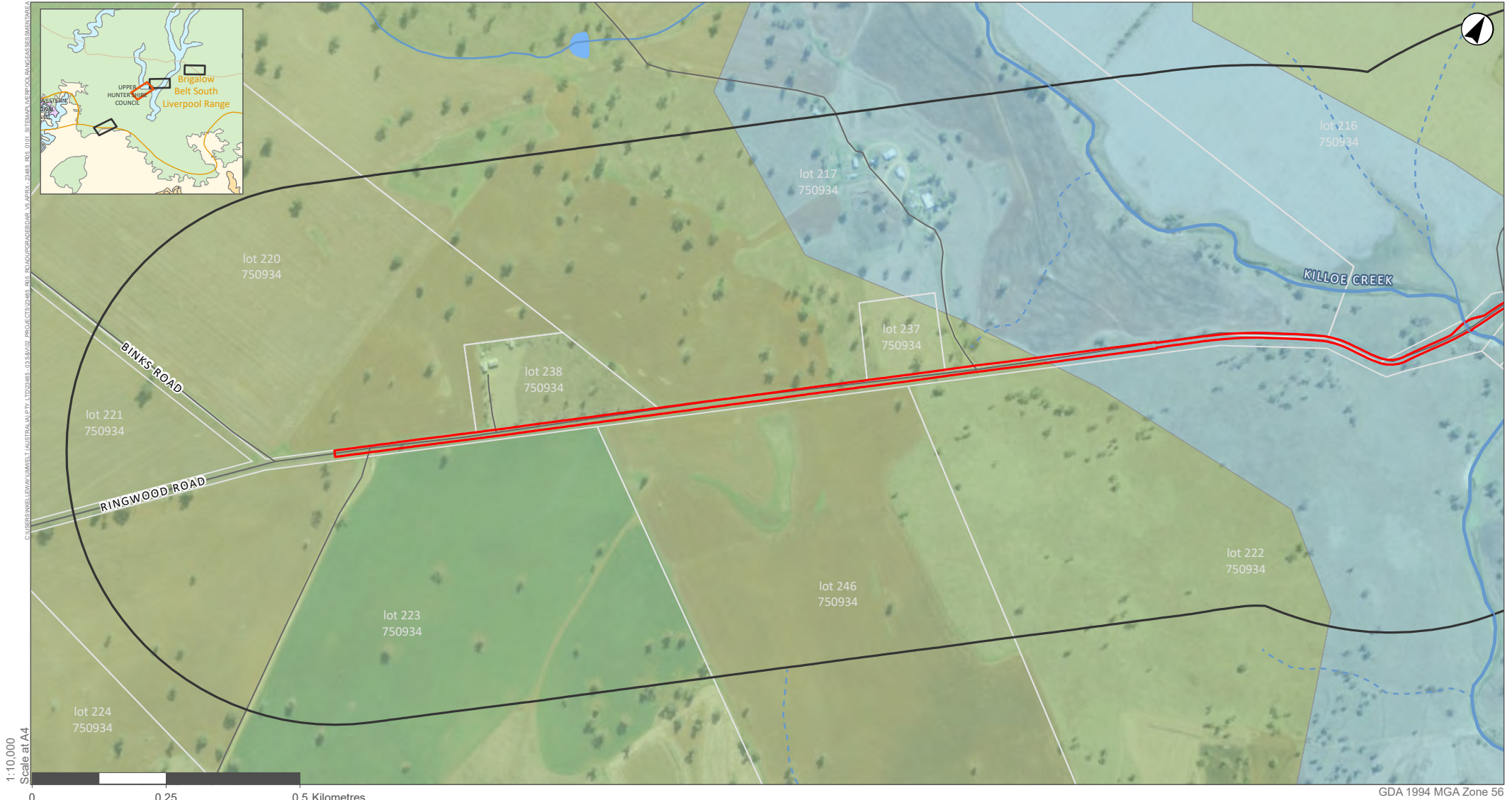
0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - Development Footprint
 - Assessment Area
 - Waterbodies
- Stream Order**
- 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- IBRA Region/Subregion**
- IBRA Region/Subregion
- Mitchell Landscapes**
- Cassilis Slopes
 - Goulburn River Channels and Floodplains
 - Goulburn River Gorges
 - Lees Pinch Foothills
 - Liverpool Range Valleys and Foothills

FIGURE 1.1A
Site Map – Liverpool Range IBRA
Subregion Assessment Area

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- IBRA Region/Subregion**
- Cassilis Slopes
 - Goulburn River Channels and Floodplains
 - Goulburn River Gorges
 - Lees Pinch Foothills
 - Liverpool Range Valleys and Footslopes

FIGURE 1.1B
Site Map – Liverpool Range IBRA Subregion Assessment Area



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Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Development Footprint
 - Assessment Area
 - Waterbodies
 - Stream Order**
 - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
 - IBRA Region/Subregion
 - Mitchell Landscapes**
 - Cassilis Slopes
 - Goulburn River Channels and Floodplains
 - Goulburn River Gorges
 - Lees Pinch Foothills
 - Liverpool Range Valleys and Foothills

FIGURE 1.1C
Site Map – Liverpool Range IBRA
Subregion Assessment Area

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- IBRA Region/Subregion**
- ▭ Cassilis Slopes
 - ▭ Goulburn River Channels and Floodplains
 - ▭ Goulburn River Gorges
 - ▭ Lees Pinch Foothills
 - ▭ Liverpool Range Valleys and Footslopes

FIGURE 1.1D
Site Map – Liverpool Range IBRA Subregion Assessment Area

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



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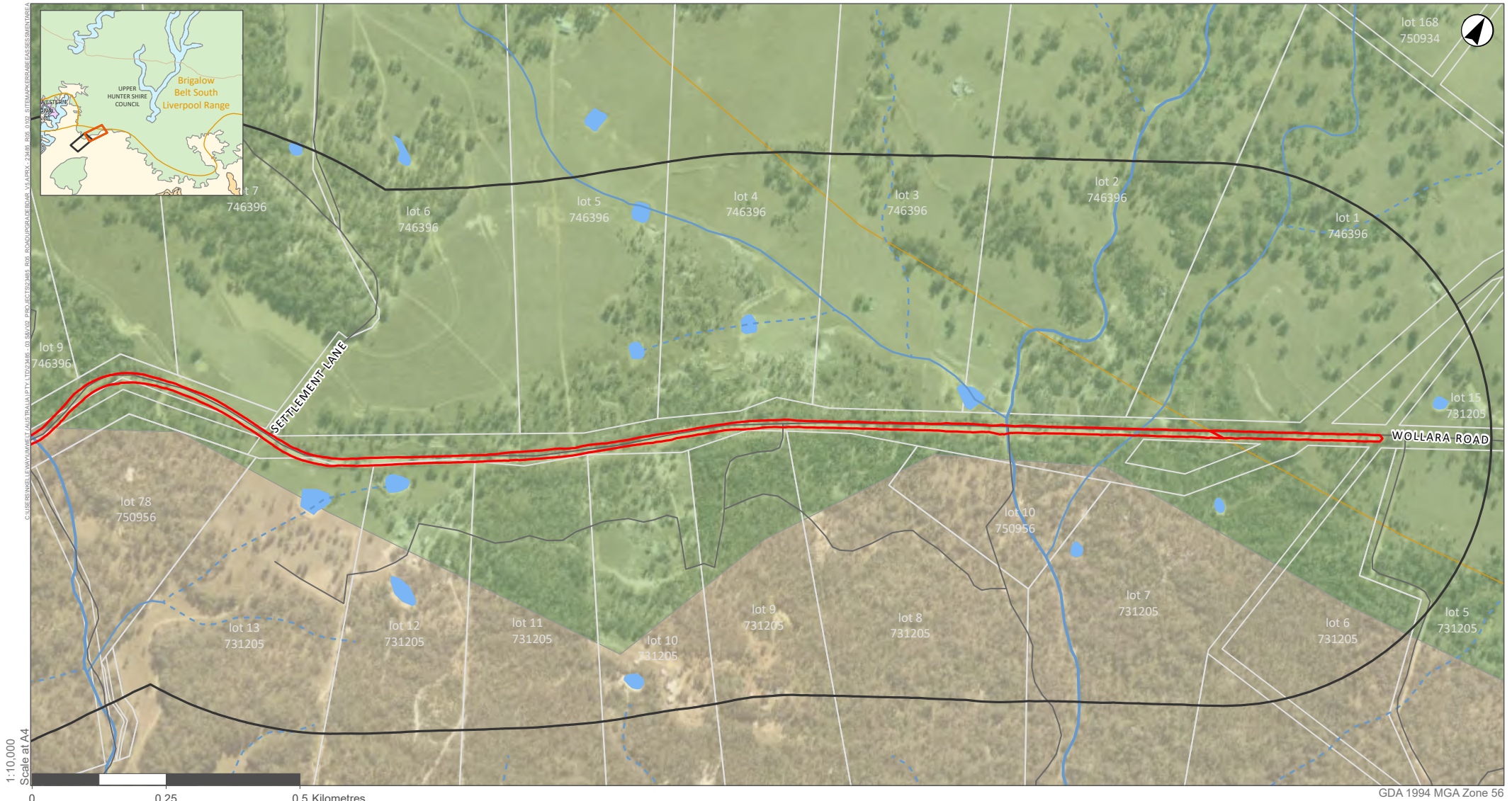
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GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- IBRA Region/Subregion**
- ▭ Cassillis Slopes
 - ▭ Goulburn River Channels and Floodplains
 - ▭ Goulburn River Gorges
 - ▭ Lees Pinch Foothills
 - ▭ Liverpool Range Valleys and Foothills

FIGURE 1.2A
Site Map – Kerrabee IBRA
Subregion Assessment Area

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



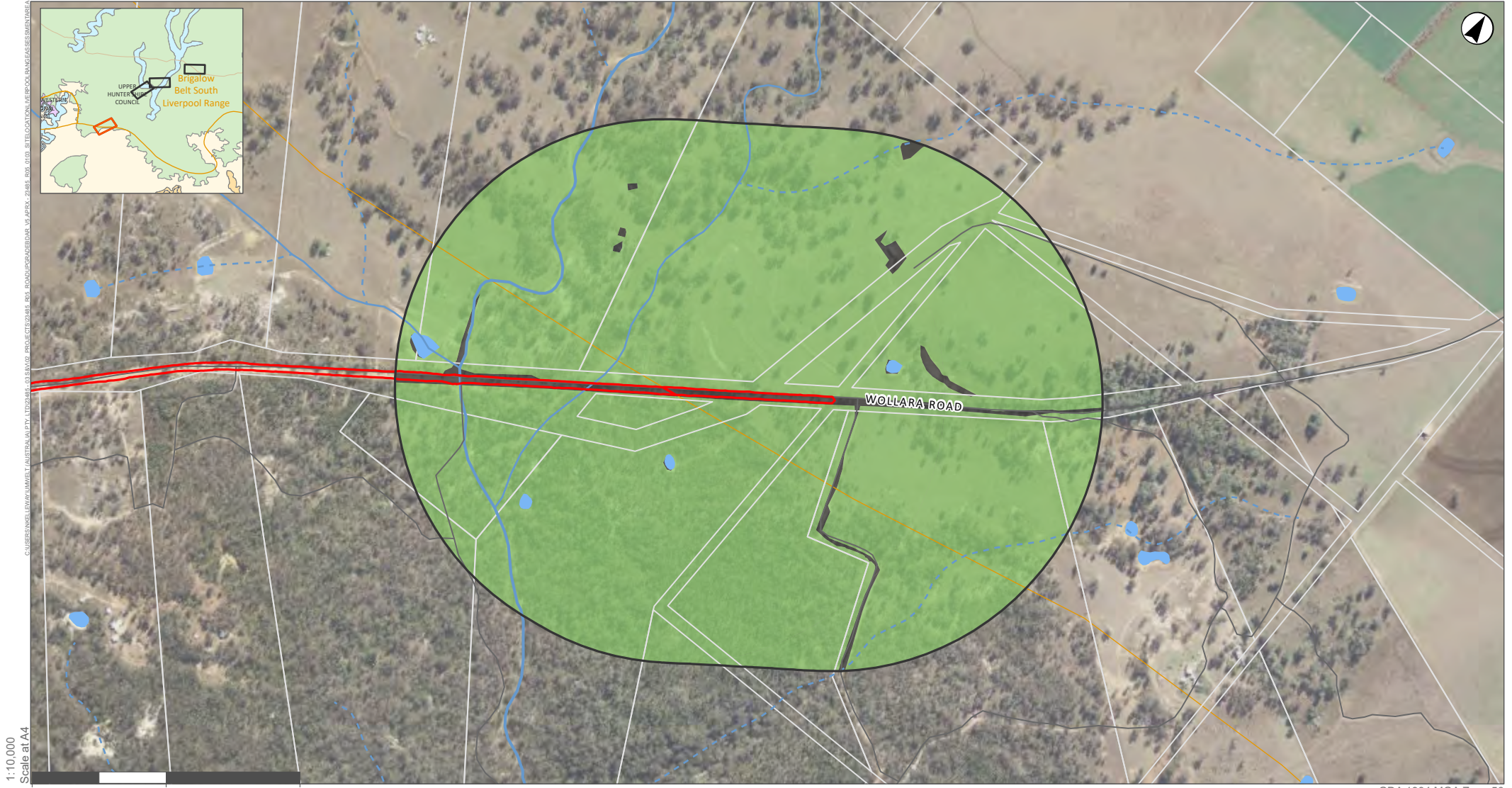
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- Legend**
- Road
 - Property Boundaries
 - Development Footprint
 - Assessment Area
 - Waterbodies
- Stream Order**
- 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- Mitchell Landscapes**
- IBRA Region/Subregion
 - Cassilis Slopes
 - Goulburn River Channels and Floodplains
 - Goulburn River Gorges
 - Lees Pinch Foothills
 - Liverpool Range Valleys and Foothills

GDA 1994 MGA Zone 56

FIGURE 1.2B
Site Map – Kerrabee IBRA
Subregion Assessment Area

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



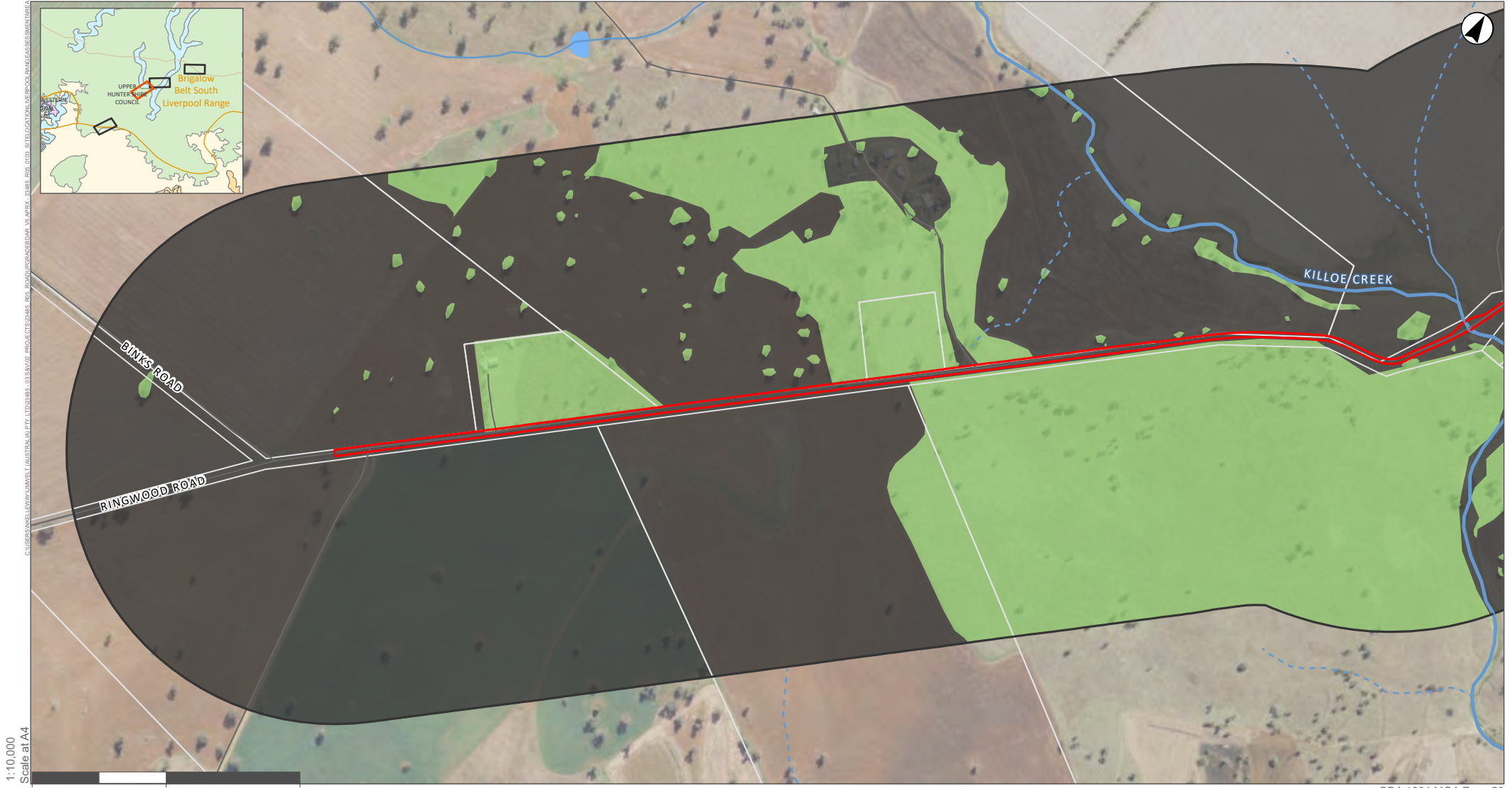
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Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
 - Stream Order**
 - - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
 - ▭ IBRA Region/Subregion
 - Vegetation Cover within Assessment Area**
 - Cleared Land
 - Native Vegetation

FIGURE 1.3A
Location Map – Liverpool Range
IBRA Subregion Assessment Area

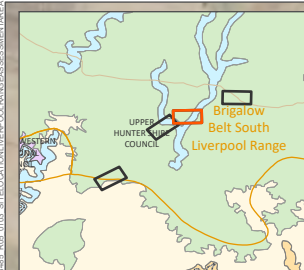


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Scale at A4

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Development Footprint
 - Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- Vegetation Cover within Assessment Area**
- IBRA Region/Subregion
 - Cleared Land
 - Native Vegetation

FIGURE 1.3B
Location Map – Liverpool Range
IBRA Subregion Assessment Area



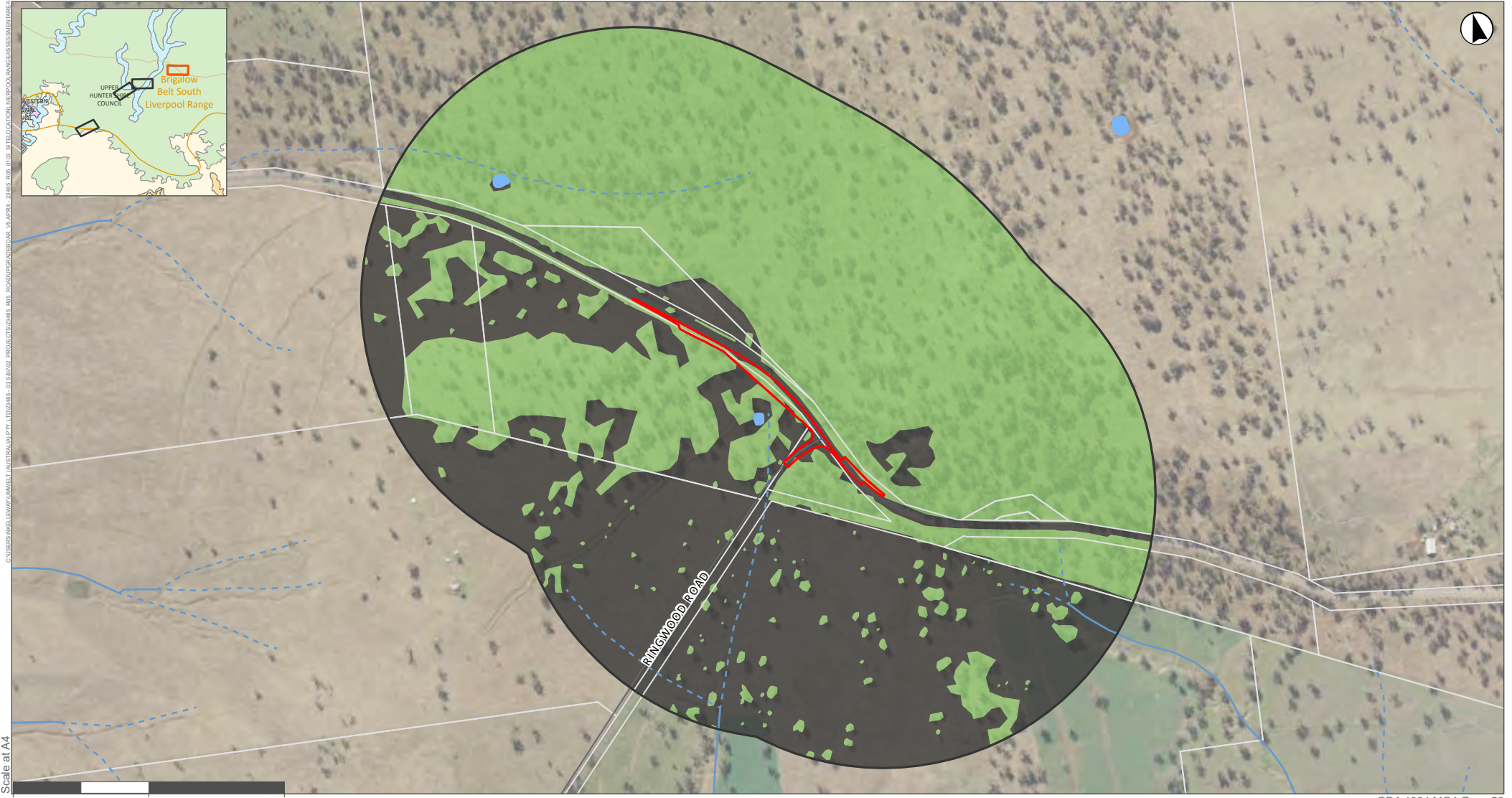
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Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- Vegetation Cover within Assessment Area**
- ▭ IBRA Region/Subregion
 - Cleared Land
 - Native Vegetation

FIGURE 1.3C
Location Map – Liverpool Range
IBRA Subregion Assessment Area



1:10,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
 - Stream Order**
 - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
 - ▭ IBRA Region/Subregion
 - Vegetation Cover within Assessment Area**
 - Cleared Land
 - Native Vegetation

FIGURE 1.3D

**Location Map – Liverpool Range
IBRA Subregion Assessment Area**



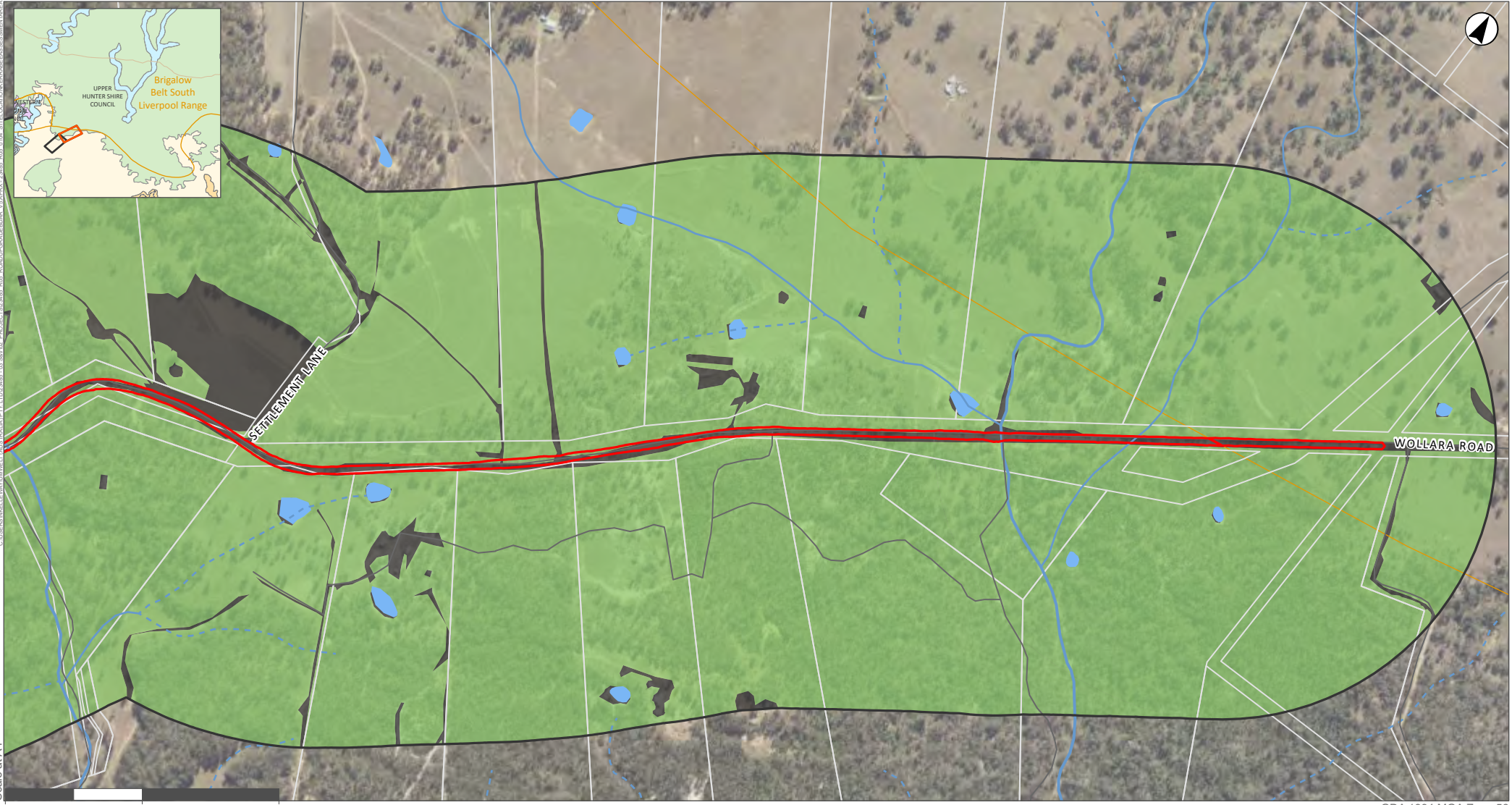
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Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- Vegetation Cover within Assessment Area**
- ▭ IBRA Region/Subregion
 - Cleared Land
 - Native Vegetation

FIGURE 1.4A
Site Location – Kerrabee IBRA
Subregion Assessment Area



1:10,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - ▭ Assessment Area
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
 - 4th Order Stream
 - 5th Order Stream or Higher
- ▭ IBRA Region/Subregion
- Vegetation Cover within Assessment Area**
- Cleared Land
 - Native Vegetation

FIGURE 1.4B
Site Location – Kerrabee IBRA
Subregion Assessment Area



1:2,750
Scale at A4

- Legend**
- Watercourse
 - Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies

GDA 1994 MGA Zone 56

FIGURE 1.5
Golden Highway Intersection Upgrade
Development Footprint



- Legend**
- Watercourse
 - Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies

FIGURE 1.6
Bow River to Binks Road Upgrade
Development Footprint

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



GDA 1994 MGA Zone 56

- Legend**
- Watercourse
 - Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies

FIGURE 1.7
Wollara Road Upgrade Development Footprint

1.3 Purpose and Scope of this Report

This BDAR has been prepared as part of the response to submissions EIS documentation and to address the Secretary's Environmental Assessment Requirements (SEARs) in relation to biodiversity for the proposed amended public road, intersection and culvert upgrade works (**Table 1.1**). Umwelt has prepared a separate BDAR for the solar farm component of the Project.

On 2 February 2022, the Project was determined to be a Controlled Action requiring approval under the EPBC Act by the Commonwealth Minister for the Environment due to its potential impact on listed threatened species and ecological communities.

The assessment path for the Project is under the bilateral agreement between the Commonwealth and NSW Government. The Department of Climate Change, Energy the Environment and Water (DCCEEW) determined it a controlled action on 2 February 2022 and issued assessment requirements which were issued as Supplementary SEARs for the Project (refer to Appendix 1 of the EIS). A summary of the assessment findings related to MNES is included in Section 7.0 of the EIS and Part B of the Amendment Report.

The controlled action decision (EPBC 2021/ 9102) relates to the Solar Farm Project. The proponent is applying for a variation to the action to also include the road upgrades. This application is being done in parallel to the Amendment Report assessment, with timing determined in consultation with DPE and DCCEEW. The Road Upgrades BDAR includes the assessment of potential impacts to MNES associated with the road improvements.

The BAM has been endorsed as the assessment method for MNES under a Bilateral Agreement made under the EPBC Act. The Australian Government is the decision-maker for whether the Project will be approved under the EPBC Act. Nationally listed threatened species, TECs and migratory species have been considered and assessed as part of this BDAR.

Table 1.1 SEARs Relevant to the Biodiversity Assessment

Key Issues	Secretary's Environment Assessment Requirements	Where Addressed
SEARs		
Biodiversity	An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the BC Act, the Biodiversity Assessment Method (BAM) 2020 and documented in a Biodiversity Development Assessment Report (BDAR), unless BCS and DPIE determine the proposed development is not likely to have any significant impacts on biodiversity values	The BDAR itself
	The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM	Section 6.0 and Section 7.0 of this BDAR
	An assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the <i>Fisheries Management Act 1994</i> (FM Act), and a description of the measures to minimise and rehabilitate impacts, and	Appendix A of this BDAR
	If an offset is required, details of the measures proposed to address the offset obligations.	Section 11.1 of this BDAR
Biodiversity Conservation Division (BCD) Submission		
Biodiversity	1. Biodiversity impacts related to the proposed development (SSD-33964533) are to be assessed in accordance with the Biodiversity Assessment Method 2020 and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the BC Act (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method 2020.	The BDAR itself
	2. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method 2020.	Section 6.0 and Section 7.0 of this BDAR
	3. The BDAR must include details of the measures proposed to address the offset obligation as follows: <ul style="list-style-type: none"> • The total number and classes of biodiversity credits required to be retired for the development/project. • The number and classes of like-for-like biodiversity credits proposed to be retired. • The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules. • Any proposal to fund a biodiversity conservation action. • Any proposal to conduct ecological rehabilitation (if a mining project). 	Section 11.1 of this BDAR

Key Issues	Secretary's Environment Assessment Requirements	Where Addressed
	<ul style="list-style-type: none"> Any proposal to make a payment to the Biodiversity Conservation Fund. <p>If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.</p>	
	4. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the BC Act.	Section 1.5 of this BDAR
EPBC Act Assessment Requirements – supplementary SEARs		
General requirements – Relevant regulations	5. The Environmental Impact Statement (EIS) must address all matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth) and all matters outlined below in relation to the controlling provisions.	This BDAR itself. Section 10.0 of this BDAR
General requirements – Project description	6. The title of the action, background to the action and current status.	Section 1.2 of this BDAR
	7. The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on MNES.	
	8. How the action relates to any other actions that have been, or are being taken in the region affected by the action.	
	9. How the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts on MNES.	
General requirements – Impacts	10. The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including: <ul style="list-style-type: none"> i. a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long term relevant impacts; ii. a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible; iii. analysis of the significance of the relevant impacts; and iv. any technical data and other information used or needed to make a detailed assessment of the relevant impacts. 	Section 10.9 of this BDAR
General requirements – Avoidance,	11. For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including:	Section 10.8 of this BDAR

Key Issues	Secretary's Environment Assessment Requirements	Where Addressed
mitigation, and offsetting	<ul style="list-style-type: none"> v. a description, and an assessment of the expected or predicted effectiveness of the mitigation measures, vi. any statutory policy basis for the mitigation measures; vii. the cost of the mitigation measures; viii. an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing; ix. the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program. 	
	<p>12. Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.</p>	<p>Section 10.10 of this BDAR</p>
	<p>13. For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any conservation advice or recovery plan for the species or community</p> <ul style="list-style-type: none"> x. relevant threat abatement plan for the species or community xi. wildlife conservation plan for the species xii. any strategic assessment. <p>Note: the relevant guidelines and policy statements for each species and community are available from the Department of the Environment Species Profiles and Threats Database. (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl)</p>	<p>Section 10.5.1, Section 10.6.1.1, Section 10.6.2.1 of this BDAR</p>
	<p>14. In addition to the general requirements described above, specific information is required with respect to each of the determined controlling provisions. These requirements are outlined in paragraphs 15–17.</p>	<p>Section 2.0 of this BDAR Section 4.0 of this BDAR Section 5.0 of this BDAR Section 6.0 of this BDAR Section 9.0 of this BDAR Section 10.9 of this BDAR</p>

Key Issues	Secretary's Environment Assessment Requirements	Where Addressed
Biodiversity (threatened species and communities and migratory species)	<p>15. The EIS must identify each EPBC Act listed threatened species and community and migratory species likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.</p>	<p>Section 10.9 of this BDAR</p>
	<p>16. For each of the EPBC Act listed threatened species and communities and migratory species likely to be impacted by the action the EIS must provide a separate:</p> <ul style="list-style-type: none"> a. description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans; b. details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; c. description of the relevant impacts of the action having regard to the full national extent of the species or community's range; and d. description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action; e. identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account; f. a description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established. g. details of how the current published NSW Biodiversity Assessment Method (BAM) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and h. details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the BAM and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites. 	<p>Section 2.0 of this BDAR Section 4.0 of this BDAR Section 5.0 of this BDAR Section 6.0 of this BDAR Section 9.0 of this BDAR Section 10.9 of this BDAR</p>

Key Issues	Secretary's Environment Assessment Requirements	Where Addressed
	<p>Note: For the purposes of approval under the EPBC Act, it is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action and deliver an overall conservation outcome that improves or maintains the viability of the MNES i.e. 'like-for-like'. In applying the BAM, residual impacts on EPBC Act listed TECs must be offset with Plant Community Type(s) (PCT) that are ascribed to the specific EPBC listed ecological community. PCTs from a different vegetation class will not generally be acceptable as offsets for EPBC listed communities.</p> <p>17. Any significant residual impacts not addressed by the BAM may need to be addressed in accordance with the EPBC Act 1999 Environmental Offset Policy. (http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy.)</p>	
Appendix A Protected matters relevant to the Goulburn River Solar Farm (EPBC 2021/9102) project	<p>Based on the information in the referral documentation, the location of the action, species records and likely habitat present in the area, there are likely to be significant impacts to:</p> <ul style="list-style-type: none"> • White Box-Yellow Box-Blakley's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered. • Regent Honeyeater (<i>Anthochaera phrygia</i>) – Critically Endangered. <p>Additionally, there is some risk that there may be significant impacts on the following matters and further assessment to determine if the communities and species listed below are present in the proposed action area and, if so, the extent to which they may be impacted by the proposed action, is required:</p> <ul style="list-style-type: none"> • Central Hunter Valley Eucalypt Forest and Woodland – Critically Endangered. • Swift Parrot (<i>Lathamus discolor</i>) – Critically Endangered. • Painted Honeyeater (<i>Grantiella picta</i>) – Vulnerable. • Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>) – Endangered • Corben's Long-eared Bat (<i>Nyctophilus corbeni</i>) – Vulnerable. • Pink tailed Worm-lizard (<i>Aprasia parapulchella</i>) – Vulnerable. • Bluegrass (<i>Dichanthium setosum</i>) – Vulnerable. • <i>Homoranthus darwinioides</i> – Vulnerable. 	Section 10.0 of this BDAR

Key Issues	Secretary's Environment Assessment Requirements	Where Addressed
	<p>Several threatened species and ecological communities have been identified as priority management species following the 2019-20 bushfires. This includes the White Box-Yellow Box-Blakley's Red Gum Grassy Woodland and Derived Native Grassland threatened ecological community and the Regent Honeyeater (as discussed above), and the following listed species that may be impacted by the proposed action:</p> <ul style="list-style-type: none"> • Koala (<i>Phascolarctos cinereus</i>) (Combined Population of QLD, NSW and the ACT) – Vulnerable. • Southern Greater Glider (<i>Petauroides volans</i>) – Vulnerable. • Brush tailed Rock wallaby (<i>Petrogale penicillata</i>) – Vulnerable. • Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (<i>Dasyurus maculatus maculatus</i> (South-east mainland population)) – Endangered. • New Holland Mouse, Pookila (<i>Pseudomys novaehollandiae</i>) – Vulnerable. • Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>) – Vulnerable. <p>Further analysis of the impacts of the fires on those species and communities identified above should be undertaken during the assessment.</p> <p>Note: uncertainty around the extent and number of protected matters that may be impacted will need to be resolved through the assessment process once final alignment and construction plans have been completed.</p> <p>Note: this may not be a complete list and it is the responsibility of the proponent to ensure any protected matters under these controlling provisions are assessed for the Commonwealth decision-maker's consideration.</p>	

1.4 Statutory Considerations

Commonwealth and state legislation relevant to this BDAR is described in **Table 1.2**.

Table 1.2 Legislation Relevant to the Project

Relevant Legislation	Governing Agency	Summary
Commonwealth Legislation		
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	<p>The EPBC Act is the Commonwealth Government’s primary piece of environmental legislation and is administered by the Australian Government DCCEEW. It is designed to protect national environmental assets, known as MNES, which include threatened species of flora and fauna, endangered ecological communities, and migratory species, as well as other protected matters. It defines the categories of threat for threatened flora and fauna, identifies key threatening processes and provides for the preparation of recovery plans for threatened flora, fauna, and communities.</p> <p>Preliminary investigations identified that the Solar Farm component of the Project would likely have a significant impact on biodiversity protected under the EPBC Act. A referral was subsequently prepared and submitted, with the Proposal being determined to be a controlled action (ref 2021/9102) under the EPBC Act on 2 February 2022. The proponent is applying for a variation to the action to also include the road upgrades. This application is being done in parallel to the Amendment Report assessment, with timing determined in consultation with DPE and DCCEEW.</p> <p>An MNES assessment for the parts of the Project assessed within this Report is found within Section 10.0 of this BDAR.</p>
NSW Legislation		
<i>Environmental Planning and Assessment Act 1979</i> (EP&A Act)	Department of Planning and Environment (DPE)	<p>The EP&A Act is the overarching planning legislation in NSW that provides for the creation of planning instruments that guide land use. The EP&A Act also provides for the protection of the environment, including the protection and conservation of native animals and plants. This includes threatened species, populations and ecological communities, and their habitats of biodiversity values, as listed in the NSW BC Act and NSW FM Act.</p> <p>Section 4.36 of the EP&A Act provides for the declaration of a project as SSD. Under the EP&A Act, the declaration of a project as SSD can be made by meeting the requirements of a State Environmental Planning Policy (SEPP) or by the Minister for Planning and Homes.</p> <p>Clause 20 of Schedule 1 of Planning Systems SEPP prescribes that development for the purpose of ‘electricity generating works’ that has a capital investment value of more than \$30 million is SSD. The Project has a capital investment value of greater than \$30 million.</p> <p>As SSD, the Project would be assessed under Part 4 Division 4.7 section 4.36 of the EP&A Act. The Minister for Planning and Public Spaces is the consent authority for SSD. The Minister (or the Minister’s delegate) is required to take into consideration the matters listed under section 4.15 of the EP&A Act when determining the development application (DA).</p> <p>Under Division 4.4 section 4.39 an EIS is required to accompany a DA that has been determined as SSD. The proponent is required to consult with the Secretary of DPE with regard to the matters to be addressed in the EIS. These are referred to as the SEARS.</p>

Relevant Legislation	Governing Agency	Summary
		The SEARs for the Project were issued by DPE on 1 February 2021. Broadly, the SEARs require biodiversity impacts related to all stages of a proposal to be assessed in accordance with section 7.9 of the BC Act and documented in a BDAR. The SEARs and where this BDAR addresses each requirement pertaining to biodiversity are summarised in Table 1.1 .
<i>Biodiversity Conservation Act 2016 (BC Act)</i>	DPE	<p>The BC Act and its supporting regulations commenced on 25 August 2017. The BC Act sets out the environmental impact assessment framework for threatened species, TECs and Areas of Outstanding Biodiversity Value (formerly critical habitat) for Major Projects, Part 5 activities, and local development.</p> <p>The BC Act provides a framework to avoid, minimise and offset the impacts of proposed development and established a methodology for assessing the likely impacts on biodiversity values and calculating measure to offset those impacts (the BAM). Section 7.9 of the BC Act requires that SSD under Part 4 of the EP&A Act that triggers the Biodiversity Offset Scheme (BOS) must be accompanied by a BDAR prepared by an accredited assessor in accordance with the BAM.</p>
Biodiversity Conservation Regulation 2017 (BC Regulation)	DPE	The BC Regulation commenced on 25 August 2017. The object of the BC Regulation is to make provision for matters that are required or authorised to be prescribed as a consequence of the enactment of the BC Act. The BC Regulation provides the thresholds which trigger the BOS, the principles for consideration of serious and irreversible biodiversity impacts, rules for meeting a biodiversity offset obligation, biodiversity certification criteria, additional biodiversity impacts to which the scheme applies and compliance provisions for unauthorised clearing and accredited assessors. This BDAR has been prepared in accordance with the provisions of the BC Regulation.
<i>National Parks and Wildlife Act 1974 (NPW Act)</i>	DPE	<p>The NPW Act provides for the protection of Aboriginal sites and designated conservation areas as well as the flora and fauna within conservation areas. The objective of the NPW Act is to consolidate and amend the law relating to the establishment, preservation and management of national parks, historic sites, certain other areas, and the protection of certain fauna, native plants and Aboriginal objects.</p> <p>There are no conservation areas listed under the NPW Act within or adjacent to the Development Footprint.</p>
<i>Fisheries Management Act 1994 (FM Act)</i>	Department of Primary Industries (DPI)	<p>The objectives of the FM Act are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. More detailed objectives relevant to the Project include:</p> <ul style="list-style-type: none"> • to conserve fish stocks and key fish habitats • to conserve threatened species, populations and ecological communities of fish and marine vegetation • to promote ecologically sustainable development, including the conservation of biological diversity. <p>An Aquatic Assessment which includes an assessment of the likely impacts on listed aquatic threatened species, populations and ecological communities under the FM Act is provided in Appendix A of this BDAR.</p>

Relevant Legislation	Governing Agency	Summary
<i>Biosecurity Act 2015</i>	DPI	The Biosecurity Act replaced the <i>Noxious Weeds Act 1993</i> on 1 July 2017. The Biosecurity Act is a wide-ranging legislation that outlines the requirements of government, councils, private landholders, and public authorities in the management of biosecurity matters. Priority weeds are regulated under the Biosecurity Act with a general biosecurity duty to prevent, eliminate or minimize any biosecurity risk they may pose. Some priority weeds have additional management obligations which may apply generally, or under specific circumstances. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised as is reasonably practicable.
<i>Local Land Services Act 2013</i> (LLS Act)	Local Land Services (LLS)	<p>The LLS Act, supported by the Local Land Services Regulation 2014 (LLS Regulation), established 11 regional Local Land Services organisations to provide biosecurity, natural resources management and agricultural advisory services.</p> <p>Under Part 5A of the LLS Act and the supporting regulation, a Native Vegetation Regulation (NVR) map showing the extent of categorised land in NSW is to be published by the Environment Agency Head. The NVR map underpins the legislative framework for native vegetation clearing in rural areas by categorising land in NSW. However, the map applies only to the following zones (if they are not in an excluded LGA): Zone RU1 Primary Production, Zone RU2 Rural Landscape, Zone RU5 Primary Production Small Lots and Zone RU6 Transition.</p> <p>Currently, various map categories have been released under staged transitional arrangements. The online NVR map viewer currently displays Excluded Land, Category 2 – Vulnerable Land and Category 2 – Sensitive Land. Category 1 – Exempt Land and Category 2 – Regulated Land maps have not yet been released. During the transition period landholders must determine if their land is Category 1 or Category 2 under the LLS Act.</p> <p>The BAM does not need to be applied to land mapped as Category 1 – Exempt Land. The Development Footprint are zoned RU1, however have not been mapped as Category 1 – Exempt Land for the purposes of this BDAR.</p>
State Environmental Planning Policy (Biodiversity and Conservation) 2021	DPE	<p>SEPP (Biodiversity and Conservation) 2021 commenced in March 2022 and includes a number of previous planning policies including Koala Habitat Protection 2019 and Koala Habitat Protection 2021, Chapter 3 and 4, respectively. Schedule 2 identifies that the provisions of chapters 3 and 4 apply in the Upper Hunter LGA. For all RU1 (Primary Production), RU2 (Rural Landscape) or RU3 (Forestry) zoned land outside of the Sydney Metropolitan Area and Central Coast, Chapter 3 Koala Habitat Protection 2020 applies.</p> <p>Chapter 3 aims to encourage the proper conservation and management of areas of natural vegetation that may provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline. This is to be achieved through identifying areas of core Koala habitat, including these areas in environment protection zones and where required managing development consent in relation to areas of core Koala habitat.</p> <p>An assessment of impacts to Koalas under the SEPP (Biodiversity and Conservation) is provided in Section 5.6.</p>

1.5 Project Team

This BDAR was prepared by Umwelt in accordance with requirements of the BC Act and the BAM and following the specific requirements detailed within Appendix K of the BAM (see checklist in **Appendix B** of this report).

Table 1.3 outlines the details of the Umwelt Ecologists involved in the survey, calculations and reporting for the Project. CVs for key staff are provided in **Appendix C**.

Table 1.3 Accredited BAM Assessors and their role on this Project

Name	Qualifications	Years of Industry Experience	BAM Accreditation Number	Contribution to project
Jacob Manners	BSC, MWldMgt, GC Arbcult	>15	BAAS17099	Project management Report preparation GIS PCT Mapping Field surveys (Plots and threatened species) Biodiversity credit calculation
Rachel Musgrave	BSC (Hons) Ecology	>15	BAAS18032	Document Review / Project Director
Allison Riley	BSC	>20	BAAS17042	Document Review
David Sharpe	PhD, BSC App Sc	>20	-	Field surveys and threatened fauna species assessment Expert input into survey and assessment of glider species.
Ryan Parsons	BEnvScMgt (Hons)	>16	BAAS17048	Field Surveys
Sarah Hart	BSC (Zoology), MSc, GradDip EnvMgt	>10	BAAS21026	PCT Mapping Field surveys (Plots and threatened species)
Joshua Wheatley	BSC Zoology	3	-	Field surveys
Kate Schmahl	BEnvScMgt	>4	-	Field surveys (plots and threatened species)
Rachel Donnelly	BEnvScMgt	>4	-	Field surveys (threatened species)
Travis Williamson	BAGIS	>5	-	GIS Mapping
Gayle Joyce	BSC (Forestry)	>16	-	GIS Mapping

1.6 Biodiversity Offsets Scheme Entry

The BOS applies to all SSD Projects and the SEARS require a BDAR to be prepared for the Project in accordance with Section 7.9 of the BC Act. The Development Footprint also include mapped Biodiversity Values areas on the Biodiversity Values Map, as shown in **Figure 1.8**, **Figure 1.9** and **Figure 1.10**.

1.7 Excluded Impacts / Category 1 Land

The BC Act (at Clause 6.8(3)), specifies that the BAM is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on Category 1-Exempt Land (as defined in Part 5A of the LLS Act), other than prescribed impacts (as defined in clause 6.1 of the BC Regulation).

The NSW Government has undertaken a transitional approach to the release of the NVR Map. The transitional NVR Map currently does not include Category 1 Exempt Land.

The assessment of Category 1 Land under the BAM during this transitional period has been dealt with in BAM Assessor Updates (No. 22 – 6 September 2019 and No. 3 – 6 August 2018) and the guide “Determining Native Vegetation Land Categorisation for the application of the Biodiversity Offsets Scheme” (NSW DPE 2023a).

The guidance provided identifies that accredited assessors are responsible for determining areas of Category 1 Land for developments affecting rural land and requires site-based floristic assessment to verify the presence or absence of critically endangered ecological communities and critically endangered plant species.

For the purposes of this assessment, no areas of excluded impacts / Category 1 Land have been assessed for the proposed works. Umwelt have therefore not relied upon the presence of Category 1 Land and have mapped areas of low condition vegetation which do not require offsets and cleared land through the standard vegetation integrity assessment provisions under the BAM.

1.8 Matters of National Environmental Significance

The Australian Government is the decision-maker for whether the Project will be approved under the EPBC Act. Nationally listed threatened species, TECs and migratory species have been considered and assessed within **Section 10.0** of this BDAR.

1.9 Information Sources

The following key guidance documents and resources relevant to the preparation of this BDAR were reviewed:

- Biodiversity Assessment Method (NSW DPIE 2020a).
- Biodiversity Assessment Method Operational Manual – Stage 1 (NSW DPE 2022a).
- Biodiversity Assessment Method Operational Manual – Stage 2 (NSW DPE 2023b).
- Biodiversity Assessment Method (BAM) Calculator User Guide (NSW OEH 2017).
- NSW BioNet including the BioNet Atlas, BioNet Vegetation Database and Threatened Species Data Collection (NSW DPE 2023c).
- Guidance for the Biodiversity Development Assessment Report Template (including the template) (NSW DPE 2022b).

- Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment method (NSW DPIE 2020b).
- Flora Species with Specific Survey Requirements List Version 1 (NSW DPIE 2020c).
- ‘Species Credits’ threatened bats and their habitats (NSW OEH 2018).
- NSW Survey Guide for Threatened Frogs (NSW DPIE 2020d).
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (NSW DEC 2004).
- Threatened Reptiles: Biodiversity Assessment Method survey guide (DPE 2022c).
- Koala (*Phascolarctos cinereus*): Biodiversity Assessment Method survey guide (DPE 2022d).

Other information sources relied upon are referenced in the text and are listed in the **Section 12.0** of this report.

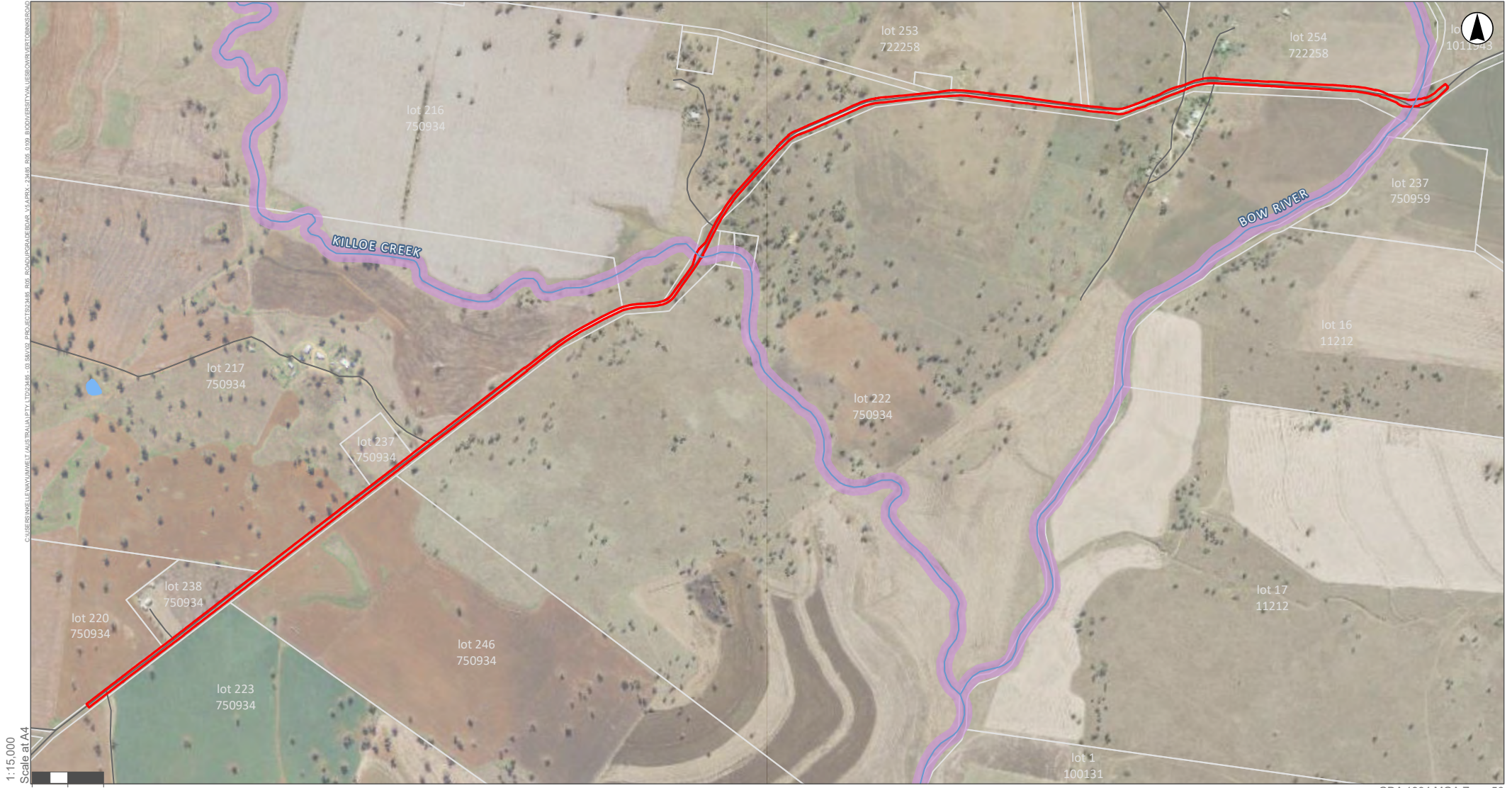


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Scale at A4

- Legend**
- Watercourse
 - Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies
 - Biodiversity Values Map

GDA 1994 MGA Zone 56

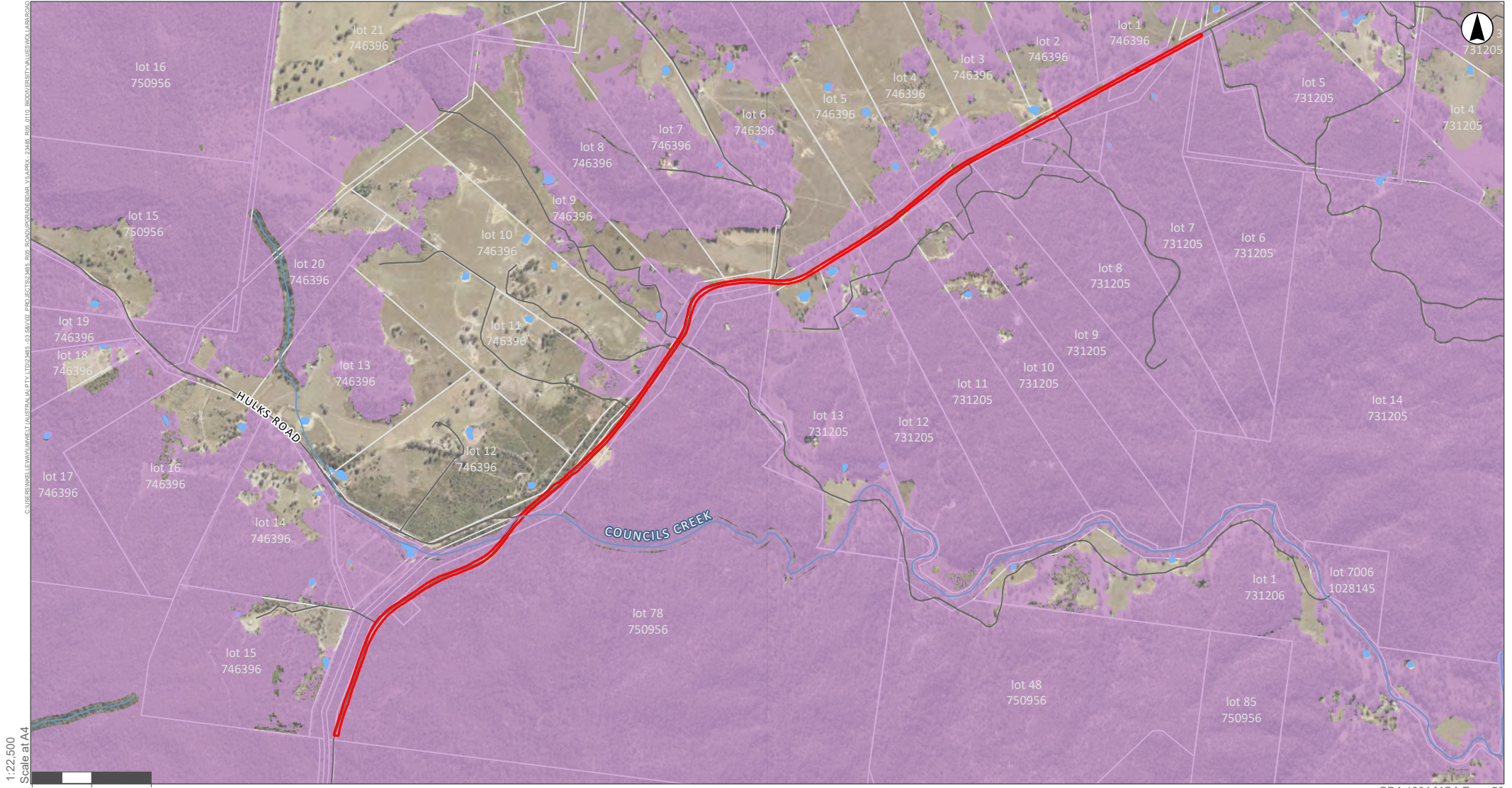
FIGURE 1.8
Biodiversity Values Map - Golden Highway Intersection Upgrade Development Footprint



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0 0.1 0.2 Kilometres

- Legend**
- Watercourse
 - Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies
 - Biodiversity Values Map

FIGURE 1.9
Biodiversity Values Map - Bow River to Binks Road Upgrade Development Footprint



GDA 1994 MGA Zone 56

- Legend**
- Watercourse
 - Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies
 - Biodiversity Values Map

FIGURE 1.10
Biodiversity Values Map - Wollara Road Upgrade Development Footprint

2.0 Methods

2.1 Site Context Methods

2.1.1 Landscape Features

As detailed in Section 3 of the BAM (DPIE 2020a), a landscape assessment around the proposed works is required, which was initially conducted as a desktop assessment and confirmed during field surveys. The landscape and site context features in **Table 2.1** were identified for each Assessment Area (500 m buffer) in accordance with Section 3 of the BAM (DPIE, 2020a).

Table 2.1 Landscape Features Assessed and Data Sources

Landscape and Site Context Features	Data Source
IBRA Bioregions	Interim Biogeographic Regions of Australia (IBRA region and subregion) – Version 7 (DCCEEW 2024)
IBRA Subregions	Interim Biogeographic Regions of Australia (IBRA region and subregion) – Version 7 (DCCEEW 2024)
NSW Mitchell Landscapes	NSW (Mitchell) Landscapes Version 3.1 (DPIE 2016)
Native vegetation extent within designated assessment buffer areas	Aerial imagery
Patch Size	Aerial imagery
Cleared Areas	Aerial imagery
Rivers and Streams (classified according to stream order)	NSW Hydrography (2022)
Estuaries and Wetlands	Directory of important wetlands in Australia
Connectivity features	Aerial imagery
Karst, caves, crevices, cliffs, rocks and other geological features of significance	Aerial imagery and topographic maps
Areas of Outstanding Biodiversity Value	Areas of Outstanding Biodiversity Value register

2.2 Native Vegetation, Threatened Ecological Communities and Vegetation Integrity Methods

2.2.1 Existing Information

The following existing information was reviewed and analysed to inform the identification of plant community types (PCTs) (**Section 4.2**) and TECs (**Section 4.3**):

- NSW State Vegetation Type Map Version C2.0M2.0 (NSW DPE, 2023d).
- Notice and Reason for the Final Determination for the White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community (NSW Threatened Species Scientific Committee 2020a).
- Conservation Assessment of White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (NSW Threatened Species Scientific Committee 2020b).
- Approved Conservation Advice for the White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (DCCEEW 2023a).
- EPBC Act Policy Statement 3.5 – White Box – Yellow Box – Blakely’s Red Gum grassy woodlands and derived native grasslands (DEH 2006a).
- White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland Ecological Community Species List (DEH 2006b).
- Commonwealth Listing Advice on Whit’ Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (TSSC 2006).

2.2.2 Mapping Native Vegetation Extent and Plant Community Types

The native vegetation extent (**Section 4.1**) within the Development Footprint was determined during site surveys, through Geographic Information System (GIS) mapping and aerial photograph interpretation using the most recent publicly available aerial imagery. Native vegetation and PCT mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- Review of aerial imagery to assess vegetation distribution patterns as dictated by change in canopy texture, tone, and colour, as well as topography.
- Review of the modelled distribution of vegetation communities within broader scale regional based vegetation mapping.
- Preparation of a draft plant community type map based on interpretation of digital aerial imagery.
- Field-based ground-truthing of the draft plant community type, including surveys of rapid data points, GPS plotting of boundaries of floristic assemblage change and identification of tree dominant species.
- Confirmation of vegetation community floristic delineations based on plot data.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Slight variations in species composition are typical across the extent of a community and are often associated with microhabitats or ecotones with adjoining plant communities.

The extent of native ground-cover vegetation within offsite areas where a canopy of native species is absent has mostly been estimated based on the visual interpretation of aerial imagery, taking into account areas of cultivation and fenced boundaries. The offsite mapping of native vegetation extent is broad-scale and was prepared specifically for the estimation of native vegetation cover under the BAM (DPIE, 2020a).

2.2.3 Plot-Based Floristic and Vegetation Integrity Survey

A stratified plot-based survey of the Development Footprint was undertaken in accordance with Table 3 and Section 4.2.1 of the BAM.

Plot-based vegetation surveys were completed to assess vegetation composition, structure, function, enable calculation of the vegetation integrity scores for Vegetation Condition Zones, sample areas of expected environmental variation and verify the results of previous mapping and available site information. Each plot survey consisted of a 20 x 20 m plot nested in a larger 20 x 50 m plot. The plot data was collected in accordance with Section 4.2.1 and Section 4.3.4 of the BAM. The following information was recorded for each plot:

- Unique plot reference.
- Plot GPS coordinates (easting and northing).
- Date of the survey.
- Name of field surveyors.
- Bearing along a 50 m transect through the plot.
- Physiographic features that may assist in PCT identification such as slope, aspect and soil characteristics.
- Signs of disturbance.
- Photographs of the vegetation.
- For the nested 20 x 20 m/ 400 m² floristic plot all required vegetation composition and structure variables were recorded including:
 - Full species name for all native and exotic flora species (where sufficient diagnostic material was present).
 - Foliage cover recorded as a percentage for all alive and dead flora species rooted within and overhanging the boundaries of the plot.
 - Abundance rating for all flora species rooted within the plot.
 - All vascular plants recorded within floristic plots were identified using keys and nomenclature in Plantnet NSW Flora Online Identification Keys (The Royal Botanic Gardens and Domain Trust 2023).
- For the 20 m x 50 m plot all required vegetation function values were recorded including:
 - Tree stem size class (presence/absence or estimated abundance).
 - Tree regeneration (presence/absence).
 - Combined length of all individual fallen logs ≥10 cm diameter and ≥50 cm in length.
 - Hollow bearing trees (number of trees rooted in the plot with hollows ≥5 cm wide).

- Litter cover (all plant material that had detached from a plant and located on the ground surface) assessed as the average percentage cover of five 1 m² sub-plots spaced at 10 m intervals alternating either side of the plot midline.
- Number of large trees with a DBH ≥ the large tree benchmark for the PCT.

Plot locations were selected to ensure that they captured attributes relevant to each vegetation condition zone, to provide a representative assessment of the vegetation integrity and account for variation in the broad condition state of the vegetation condition zone. Subsequent amendments to the Development Footprint during the design process to avoid impacts to biodiversity values and work safety considerations related to working in roadside environments, have resulted in some plots located outside, but still adjacent to of the Development Footprint within representative areas.

At each plot, approximately 45 to 60 minutes was spent searching and recording all vascular flora species present within each strata of the 20 x 20 m floristic plot. Searches were generally undertaken through parallel transects from one side of the plot to another. An effort was made to search the tree canopy and tree trunks for mistletoes, vines, and epiphytes where present.

A total of 12 BAIs were sampled by Umwelt ecologists, the surveys were completed during December 2022 and August 2023. Plot locations are shown in **Figure 2.1**, **Figure 2.2** and **Figure 2.3A–D**.

Several of the BAM plots surveyed were not able to be completed entirely within the Development Footprint due to the narrow size of the impacted areas. Where this as the case the plots were located within vegetation in the adjoining road reserve which was visually assessed as having a similar or higher vegetation integrity compared to the vegetation to be impacted within the Development Footprint. This included one plot completed in better quality habitat on the northern side of the proposed intersection upgrade area, in an area where impacts were afterwards avoided as part of the design refinement process.

BAM plot stratification details are provided in **Table 2.2** for the Liverpool Range IBRA Subregion Assessment Area and **Table 2.3** for the Kerrabee IBRA Subregion Assessment Area. The field data collected for each BAM plot is provided in **Appendix D**.

Table 2.2 Plant Community Type BAM Plot Stratification Details for Liverpool Range IBRA Subregion Assessment Area

Zone No.	Vegetation Condition Zone Name	PCT ID	PCT Name	Area (ha)	Quantity of Plots Required (BAM 2020 Table 3)	Plots Completed in 2022/23
1	483 Remnant Trees	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	0.2	1 Plot	3 Plot 12 Plot 2 Plot 11

Zone No.	Vegetation Condition Zone Name	PCT ID	PCT Name	Area (ha)	Quantity of Plots Required (BAM 2020 Table 3)	Plots Completed in 2022/23
2	483 Exotic dominated derived grassland	PCT 483*	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley*	3.15	2 Plots	3 Plot 4 Plot 3 Plot 1
3	1691 Roadside remnant forest	1691	Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter	0.09	1 Plot	1 Plot 10

* Vegetation condition zone identified as original PCT from which the derived vegetation has likely developed as per BAM S4.2.

Table 2.3 Plant Community Type BAM Plot Stratification Details for Kerrabee IBRA Subregion Assessment Area

Zone No.	Vegetation Condition Zone Name	PCT ID	PCT Name	Area (ha)	Quantity of Plots Required (BAM 2020 Table 3)	Plots Completed in 2022/23
4	3334 Roadside remnant forest	3334	Western Hunter Flats Red Gum Sedge Forest	0.04	1 Plot	1 Plot 9
5	3388 Roadside remnant forest	3388	Central West Valleys White Box Forest	0.36	1 Plot	2 Plot 6 Plot 7
6	3781 Roadside remnant forest	3781	Ulan Sandstone Ironbark-Pine Woodland	1.05	1 Plot	2 Plot 5 Plot 8



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Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Development Footprint
 - IBRA Region/Subregion
 - Waterbodies
 - BAM Plot Locations
- Plant Community Types**
- Cleared Land - Road Surface
 - Exotic Dominated Grassland
 - PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

FIGURE 2.1
BAM Plot Locations - Golden Highway
Intersection Upgrade Development Footprint



1:15,000
Scale at A4

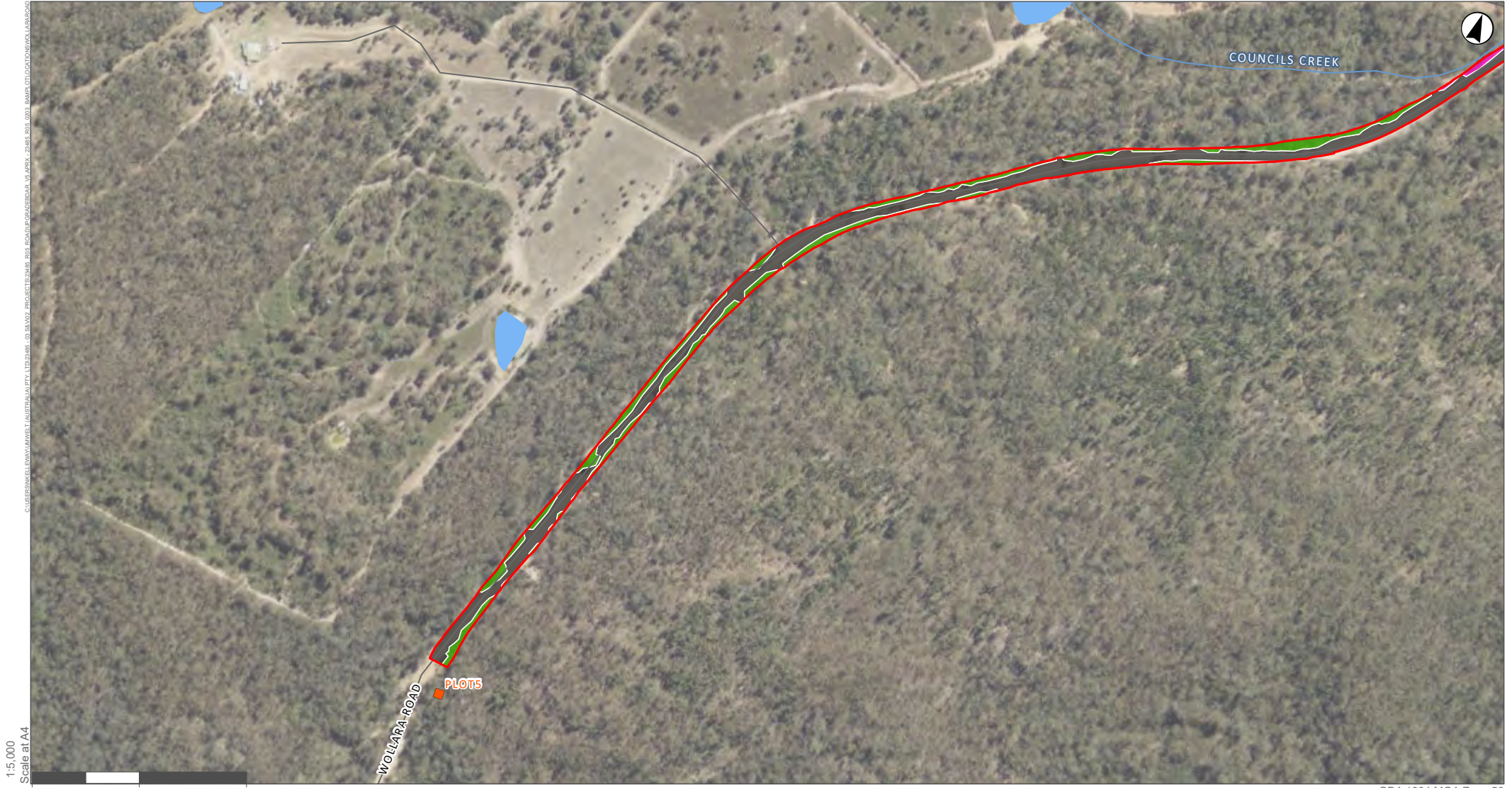
0 0.1 0.2 Kilometres

- Legend**
- Road
 - Watercourse
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - ▭ Waterbodies
 - BAM Plot Locations

- Plant Community Types**
- ▭ Cleared Land - Road Surface
 - ▭ Exotic Dominated Grassland
 - ▭ PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

GDA 1994 MGA Zone 56

FIGURE 2.2
BAM Plot Locations - Bow River to Binks Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - IBRA Region/Subregion
 - Development Footprint
 - Waterbodies
 - BAM Plot Locations
- Plant Community Types**
- Cleared Land - Road Surface
 - PCT 3388 Central West Valleys White Box Forest
 - PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.3A
BAM Plot Locations - Wollara Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - ▭ Waterbodies
 - ▭ BAM Plot Locations
- Plant Community Types**
- ▭ Cleared Land - Road Surface
 - ▭ PCT 3388 Central West Valleys White Box Forest
 - ▭ PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.3B
BAM Plot Locations - Wollara Road Upgrade Development Footprint

Image Source: ESRI Basemap (2022) Data source: NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022)



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - ▭ Waterbodies
 - BAM Plot Locations
- Plant Community Types**
- ▭ Cleared Land - Road Surface
 - ▭ PCT 3388 Central West Valleys White Box Forest
 - ▭ PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.3C
BAM Plot Locations - Wollara Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - ▭ Waterbodies
 - ◆ BAM Plot Locations
- Plant Community Types**
- ▭ Cleared Land - Road Surface
 - ▭ PCT 1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
 - ▭ PCT 3334 Western Hunter Flats Red Gum Sedge Forest
 - ▭ PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.3D
BAM Plot Locations - Wollara Road Upgrade Development Footprint

2.3 Threatened Flora Survey Methods

2.3.1 Review of Existing Information

The following existing information was reviewed to inform the threatened flora species surveys and assessment of habitat constraints and microhabitats:

- NSW Government Biodiversity Assessment Method Calculator (BAM-C).
- Threatened flora records held on the NSW BioNet Atlas within the Assessment Area (NSW DPE 2023c).
- Vegetation associations reports for the relevant IBRA bioregion and IBRA sub-region for each PCT present, to determine threatened fauna species PCT associations.
- Habitat constraints listed in the NSW BioNet Atlas under the Threatened Biodiversity Data Collection (TBDC) (DPE 2023c).
- BAM Flora species with specific survey requirements spreadsheet (DPIE 2020c).

2.3.2 Threatened Flora BioNet Atlas Records

Details of the threatened flora species recorded on the BioNet Atlas within a 1500 m buffer of the Development Footprint are listed in **Table 2.4**, including the number of records and date of records within the search area. An assessment of likelihood of occurrence for these species is also provided using the following criteria:

- High / Known – Suitable habitats which are known to support this species are present and the species is known or expected to occur within the Development Footprint based on observation or historical records.
- Moderate – Suitable habitats which are known to support this species are present within the Development Footprint and the species may occur (further surveys required).
- Low – Suitable habitats or microhabitats for this species are not present within the Development Footprint, or the Development Footprint is too disturbed to support this species and it is not known or likely to occur.

Species with a moderate or high/known occurrence are included for further assessment.

Table 2.4 Threatened Flora BioNet Records within 1.5 km

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Date Last Recorded	Number of Records within Assessment Area	Likelihood of Occurrence
<i>Homoranthus darwinioides</i>	Fairy Bells	V	V	27/01/1986	1	Moderate

2.3.3 Habitat Constraints Assessment

The following field-based surveys were undertaken to assess the habitat constraints for the candidate threatened flora species:

- Field searches for habitat constraints identified from the desktop review of the TBDC.
- Direct observation of the quality and suitability of micro-habitats present.
- Collection of site photographs to record the condition of habitats present.

The results of the site-based habitat constraints assessment were utilised to inform the assessment of the confirmed candidate threatened species assessment in the BAM-C. Where species presence could not be ruled out in accordance with Section 5.2.2 and Section 5.2.3 of the BAM, targeted surveys were conducted or the species was assumed to be present.

2.3.4 Field Surveys

Searches for threatened flora species were completed in accordance with the NSW Survey Guide, *'Surveying threatened plants and their habitats'* (DPIE 2020c) and any relevant species requirements listed in the TBDC (NSW DPE 2023c). Details of the field survey methods used and species targeted are listed in **Table 2.5** and the locations of the surveys completed are mapped in **Figure 2.2**.

Surveys for threatened flora were completed for the following PCTs:

Liverpool Range IBRA Subregion Assessment Area

- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley (Limited to Liverpool Range IBRA subregion).
- PCT 1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter.

Kerrabee IBRA Subregion Assessment Area

- PCT 3334 Western Hunter Flats Red Gum Sedge Forest (limited to Kerrabee IBRA subregion).
- PCT 3388 Central West Valleys White Box Forest.
- PCT 3781 Ulan Sandstone Ironbark-Pine Woodland.

The proposed works will impact roadside vegetation with a width of generally less than 5 m on either side of the road for all assessment areas, the Development Footprint was searched with parallel transects on each side of the road to achieve a 5 m maximum traverse spacing. Threatened flora parallel traverse surveys in compliance with a 5 m maximum spacing were undertaken as identified in **Table 2.5** and mapped in **Figure 2.4**, **Figure 2.5A-B** and **Figure 2.6A-D** Additional species-specific details of survey guideline requirements and the effort and methods undertaken are presented in **Section 5.2**.

Table 2.5 Candidate Threatened Flora Species Targeted and Field Survey Methods Used

Target Species	Species Survey Period	Survey Dates	Survey Method	IBRA Subregion	Associated PCTs
<i>Acacia ausfeldii</i>	August–September	5 December 2022	Parallel traverse at 5 m width	Kerrabee	3388, 3781
<i>Acacia pendula</i> endangered population	All year	5 December 2022 7–11 August 2023 7–9 November 2023	Parallel traverse at 5 m width	Kerrabee and Liverpool Range	1691
<i>Commersonia procumbens</i> (syn. <i>Androcalva procumbens</i>)	August–May	7–11 August 2023	Excluded based on habitat constraints	Not applicable	Not applicable
<i>Commersonia rosea</i>	All year	7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3388
<i>Cymbidium canaliculatum</i> Endangered population	All year	7–11 August 2023 7–9 November 2023	Parallel traverse at 5 m width	Kerrabee and Liverpool Range	3388, 1691
<i>Dichanthium setosum</i>	November–May	5 December 2023 (Bow River to Killoe Creek Section) 9 November 2023	Parallel traverse at 5 m width	Liverpool Range	483, 1691
<i>Diuris tricolor</i>	September–October	Not surveyed / Assumed present in associated PCTs	Not applicable	Liverpool Range	1691
<i>Eucalyptus cannonii</i>	All year	7–11 August 2023 7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3388, 3781
<i>Homoranthus darwinioides</i>	March–December	7–11 August 2023 7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3781
<i>Ozothamnus tessellatus</i>	September–October	7–9 November 2023 (surveyed outside of flowering season as can be detected without flowers)	Parallel traverse at 5 m width	Kerrabee	3388
<i>Pomaderris queenslandica</i>	All year	7–11 August 2023 7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3781
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	September–November	7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3388
<i>Prostanthera discolor</i>	September–October	7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3388
<i>Tylophora linearis</i>	October–May	7–9 November 2023	Parallel traverse at 5 m width	Kerrabee	3388



1:2,750
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

Legend

- Road
- ▭ Development Footprint
- ▭ Waterbodies

- Plant Community Types**
- ▭ Cleared Land - Road Surface
 - ▭ Exotic Dominated Grassland
 - ▭ PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

- Threatened Flora Transects**
- 2023 - August
 - 2023 - November

FIGURE 2.4

Threatened Flora Survey Locations - Golden Highway Intersection Upgrade Development Footprint



1:12,500
Scale at A4

0 0.1 0.2 Kilometres

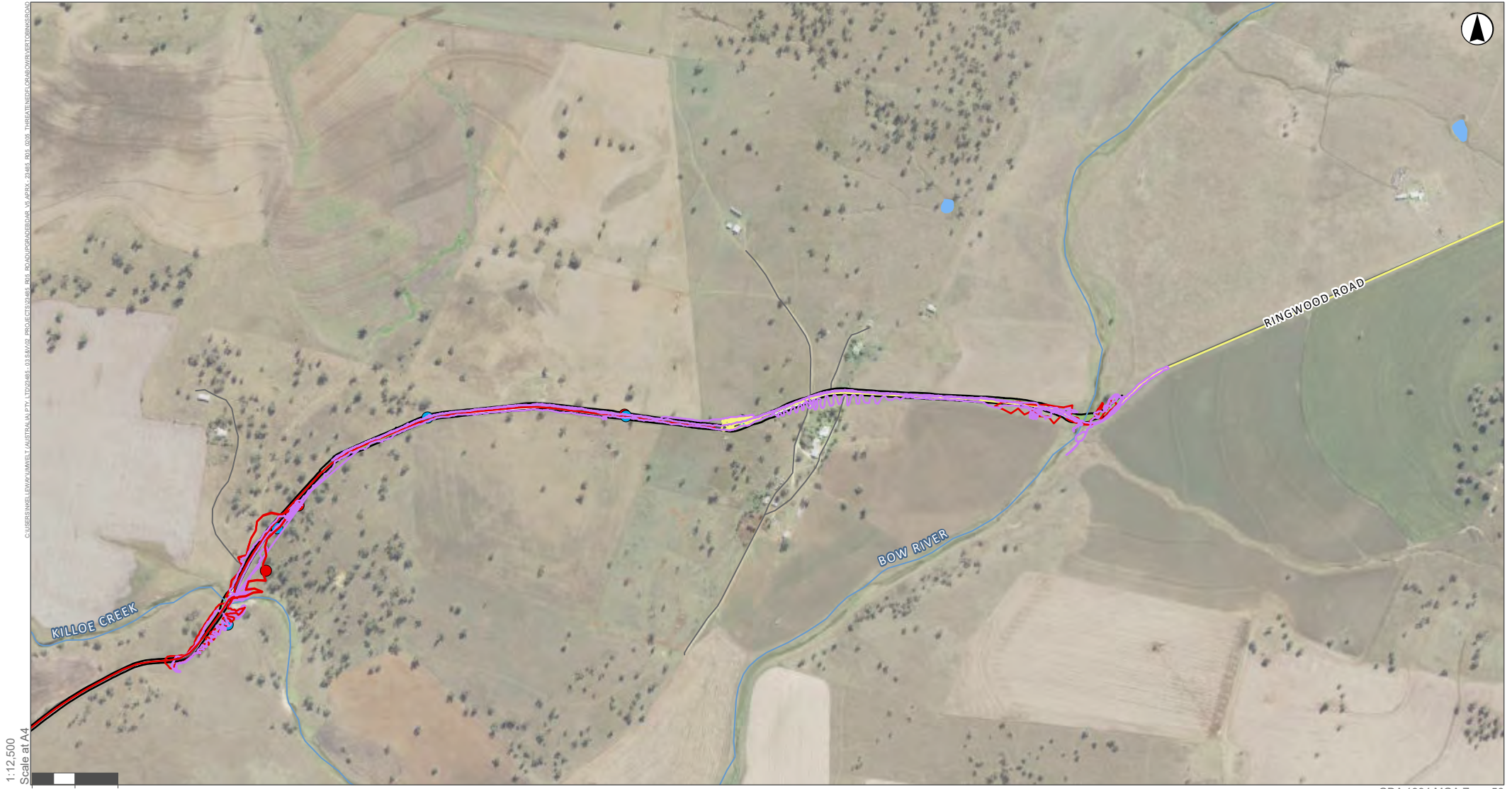
Legend

- Road
- Watercourse
- ▭ Development Footprint
- Waterbodies
- Threatened Flora Transects**
- 2022 - December

- 2023 - November
- Plant Community Types**
- Cleared Land - Road Surface
- Exotic Dominated Grassland
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

GDA 1994 MGA Zone 56

FIGURE 2.5A
Threatened Flora Survey Locations - Bow River to Binks Road Upgrade Development Footprint



1:12,500
Scale at A4

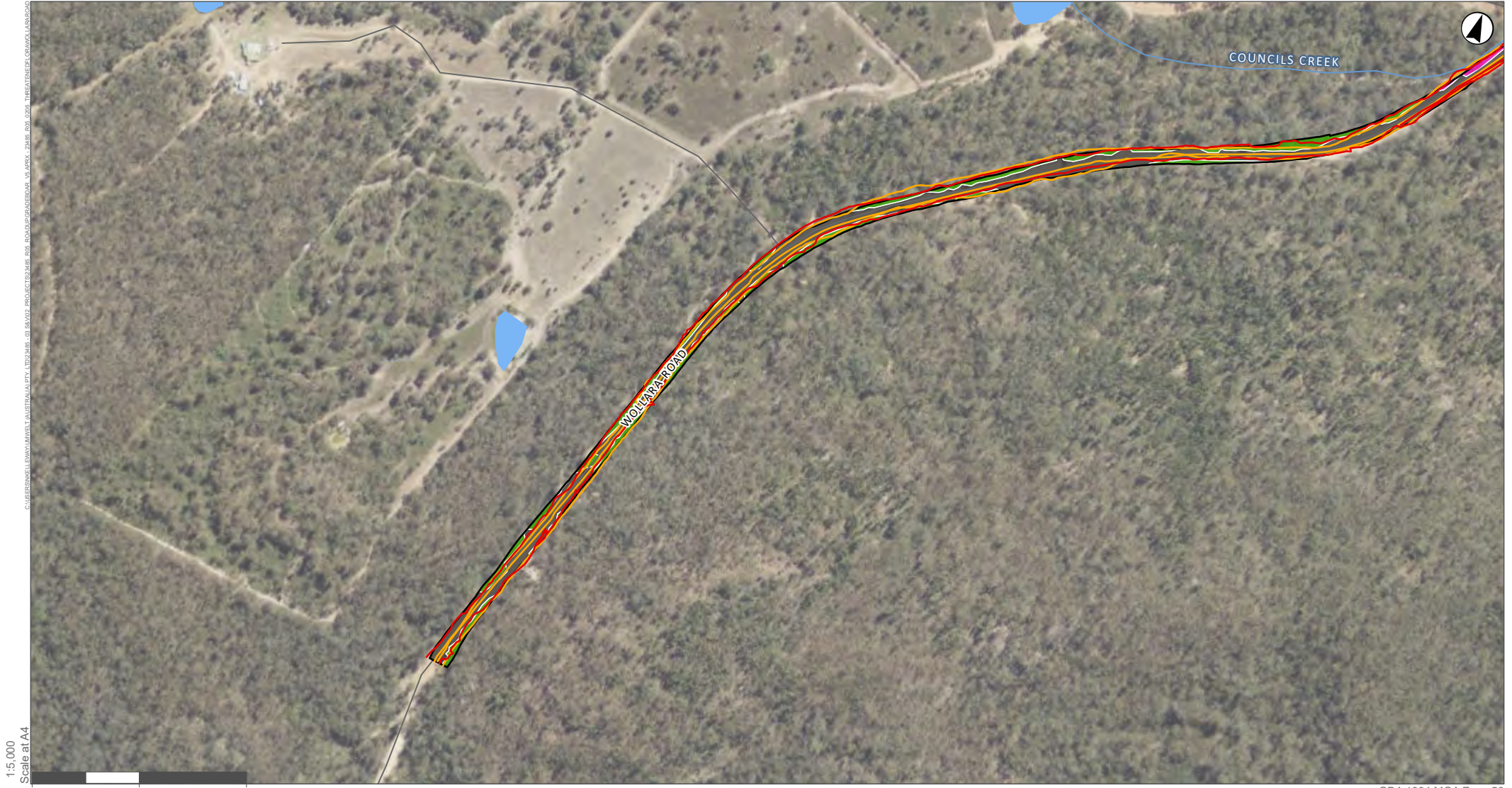
0 0.1 0.2 Kilometres

- Legend**
- Road
 - Watercourse
 - ▭ Development Footprint
 - Waterbodies
 - Threatened Flora Transects
 - 2022 - December

- 2023 - November
- Plant Community Types**
- Cleared Land - Road Surface
- Exotic Dominated Grassland
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

GDA 1994 MGA Zone 56

FIGURE 2.5B
Threatened Flora Survey Locations - Bow River to Binks Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - ▭ Development Footprint
 - Waterbodies
 - Threatened Flora Transects**
 - 2023 - August
 - 2023 - November
 - Plant Community Types**
 - Cleared Land - Road Surface
 - PCT 3388 Central West Valleys White Box Forest
 - PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.6A
Threatened Flora Survey Locations - Wollara Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - ▭ Development Footprint
 - Waterbodies
 - Threatened Flora Transects**
 - 2023 - August
 - 2023 - November
 - Plant Community Types**
 - Cleared Land - Road Surface
 - PCT 3388 Central West Valleys White Box Forest
 - PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.6B
Threatened Flora Survey Locations - Wollara Road Upgrade Development Footprint

Image Source: ESRI Basemap (2022) Data source: NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022)



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - ▭ Development Footprint
 - Waterbodies
 - Threatened Flora Transects**
 - 2023 - August
 - 2023 - November
- Plant Community Types**
- Cleared Land - Road Surface
 - PCT 3388 Central West Valleys White Box Forest
 - PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.6C
Threatened Flora Survey Locations - Wollara Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

Legend

- Road
- Development Footprint
- Waterbodies
- Threatened Flora Transects**
- 2023 - August
- 2023 - November

Plant Community Types

- Cleared Land - Road Surface
- PCT 1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- PCT 3334 Western Hunter Flats Red Gum Sedge Forest
- PCT 3781 Ulan Sandstone Ironbark-Pine Woodland

FIGURE 2.6D
Threatened Flora Survey Locations - Wollara Road Upgrade Development Footprint

2.4 Threatened Fauna Survey Methods

2.4.1 Review of Existing Information

The following existing information was reviewed to inform the threatened fauna species surveys and assessment of habitat constraints and microhabitats:

- BAM-C.
- Threatened fauna records held on the NSW BioNet Atlas within the Assessment Area (NSW DPE 2023c).
- Vegetation associations reports for the relevant IBRA bioregion and IBRAs-region for each PCT present to determine threatened fauna species PCT associations.
- Habitat constraints listed in the NSW BioNet Atlas under the TBDC (DPE 2023c).

2.4.2 Threatened Fauna BioNet Atlas Records

Details of the threatened fauna species recorded on the BioNet Atlas within a 1500 m buffer of the Development Footprint are listed in **Table 2.6**, including the number of records and date of records within the search area. An assessment of likelihood of occurrence is also provided using the following criteria:

- High / Known – Suitable habitats which are known to support this species are present and the species is known or expected to occur within the Development Footprint based on observation or historical records.
- Moderate – Suitable habitats which are known to support this species are present within the Development Footprint and the species may occur (further surveys required).
- Low – The species is not associated with the PCTs present, suitable habitats or microhabitats for this species are not present within the Development Footprint, or the Development Footprint is too disturbed to support this species and it is not known or likely to occur.

Species known to occur or with a moderate or high likelihood of occurrence have been included for further assessment.

Table 2.6 Threatened Fauna BioNet Records within 1.5 km

Common Name	Scientific Name	BC Act Status	Current EPBC Act Status	Date Last Recorded	Number of Records within Assessment Area	Likelihood of Occurrence
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	CE	23/03/2017	6	High
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	-	24/08/2020	10	Known
South-eastern Glossy Black-Cockatoo	<i>Calyptorhynchus lathami lathami</i>	V	V*	27/10/2018	1	High

Common Name	Scientific Name	BC Act Status	Current EPBC Act Status	Date Last Recorded	Number of Records within Assessment Area	Likelihood of Occurrence
Speckled Warbler	<i>Chthonicola sagittata</i>	V	-	23/08/2020	12	Known
Spotted Harrier	<i>Circus assimilis</i>	V	-	29/10/2019	2	High
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	V*	24/08/2020	29	Known
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	11/09/2018	4	High
Black Falcon	<i>Falco subniger</i>	V	-	08/01/2019	1	Moderate
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-	23/08/2020	9	High
Painted Honeyeater	<i>Grantiella picta</i>	V	V	22/10/2019	6	High
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-	27/10/2018	3	Moderate
White-throated Needle-tail	<i>Hirundapus caudacutus</i>	-	V	26/03/2019	1	High
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	E*	21/10/2020	13	Known
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	-	01/10/2019	12	High
Turquoise Parrot	<i>Neophema pulchella</i>	V	-	23/05/2019	5	High
Powerful Owl	<i>Ninox strenua</i>	V	-	08/09/2005	1	Low
Scarlet Robin	<i>Petroica boodang</i>	V	-	13/04/2007		Moderate
Diamond Firetail	<i>Stagonopleura guttata</i>	V	V*	13/10/2020	24	Known

* = Species listed after decision on referral and further consideration under EPBC Act is not required.

2.4.3 Habitat Constraints Assessment

Field-based searches were undertaken to assess habitat constraints for the candidate threatened fauna species, these searches included observation of habitat constraints identified from the desktop review of the TBDC and recording of the presence, quality and/or suitability of micro-habitats present including:

- hollow bearing trees, particularly those of suitable size for threatened cockatoo and owl breeding habitat
- koalas use trees
- aquatic habitats suitable for amphibians
- rocky habitats suitable for reptiles
- outcrops, caves, tunnels and old buildings suitable for threatened microbat species.

The results of the site-based habitat constraints assessment were utilised to inform the assessment of the confirmed candidate threatened species assessment in the BAM-C. Where species presence could not be ruled out in accordance with Section 5.2 of the BAM, surveys were conducted, or presence was assumed for associated PCTs. The fauna species credit species predicted to occur within the Development Footprint and justifications for ruling species out from further survey and assessment are identified in **Table 10.3** in **Section 5.1.2.2** below.

2.4.4 Field Surveys

Targeted surveys for candidate threatened fauna species were completed with reference to the TBDC (DPE 2023c) and following guidelines:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, NSW Department of Environment and Conservation (DEC 2004).
- Threatened Reptiles: Biodiversity Assessment Method survey guide (DPE 2022c).
- Koala (*Phascolarctos cinereus*): Biodiversity Assessment Method survey guide (DPE 2022d).
- Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the EPBC Act, Department of Sustainability, Environment, Water, Population and Communities (DSEWPC 2011a).
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act, Department of Sustainability, Environment, Water, Population and Communities (DEWHA 2010a).
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act, Department of Sustainability, Environment, Water, Population and Communities (DEWHA 2010b).
- The following subsections document the dates, weather conditions and effort for all fauna surveys completed, and species-specific details of survey guideline requirements and the effort and methods undertaken are presented in **Section 5.2**.

2.4.4.1 Diurnal Fauna Surveys

The following methods were utilised for targeting diurnal fauna species:

- Census and searches for diurnal threatened fauna species and their associated habitat constraints. Searches focussed on identifying fauna species observed or calling, signs of occupation such as scats and signs of breeding including stick nest sites and suitable hollow bearing tree breeding habitats, rocky habitats and roosts.
- Rock rolling searches with 200 suitably sized rocks turned across three survey sites within 2 hrs after sunrise or before sunset when temperatures were <25°C and cloud cover was <50%. These surveys were completed on 4 occasions at each survey site to account for variable weather conditions. A total of >2,400 rocks were rolled.
- Koala scat assessment surveys using the SPOT Assessment technique with search locations spaced by 150 m where suitable habitat / trees were present within the Development Footprint.
- Watercourse assessment.

The threatened fauna surveys completed are listed in **Table 2.7** and survey locations are mapped in **Figure 2.7**, **Figure 2.8** and **Figure 2.9A–D**.

Table 2.7 Details of Diurnal Threatened Fauna Surveys Completed

Survey Date	Survey Method	Threatened Fauna Groups Targeted	Weather Conditions	Survey Effort
5/12/2022	Diurnal census and habitat search for threatened fauna	Birds	32°C, light WNW breeze, fine	4.5 hrs x 2 people (1030–1500)
7/08/2023	Diurnal census for threatened fauna and habitat search	Birds	10–19°C, 4/8 cloud, light breeze, no rain	4 hrs x 1 person (1300–1700)
8/08/2023	Diurnal census for threatened fauna and habitat constraint survey (stick nests, hollow bearing trees, rocky areas)	Birds census and habitat search for all fauna groups (amphibians, reptiles, birds, bats, mammals)	12–19°C, 3/8 cloud, light breeze, no rain	9 hrs x 1 person (0800–1700)
9/08/2023	Diurnal census for threatened fauna and constraint survey (stick nests and hollow bearing trees)	Birds	9–20°C, 8/8 cloud, calm to light breeze, no rain	8 hrs x 1 person (0800–1600)
10/08/2023	Diurnal census for threatened fauna and constraint survey (stick nests and hollow bearing trees)	Birds	15–20°C, light breeze, 1/8 cloud, no rain	8.5 hrs x 1 person (0800–1630)
31/10/2023	Rock rolling and opportunistic diurnal threatened fauna census	Reptiles	25°C, 0/4 cloud, light breeze, fine	0.5 hrs x 2 people (1600–1630)

Survey Date	Survey Method	Threatened Fauna Groups Targeted	Weather Conditions	Survey Effort
1/11/2023	Diurnal census for threatened fauna	Birds	18–26°C, 0/8 cloud, light breeze, fine	3 hrs x 2 people (1000–1300)
1/11/2023	Rock rolling and opportunistic diurnal threatened fauna census	Reptiles	25°C, 0/8 cloud, light breeze, fine	1.25 hrs x 2 people (1700–1815)
2/11/2023	Rock rolling and opportunistic diurnal threatened fauna census	Reptiles	25°C, 0/8 cloud, light breeze, fine	1.5 hrs x 2 people (1700–1830)
7/11/2023	Opportunistic diurnal census for threatened fauna while undertaking flora searches	Birds	16–28°C, 0/8 cloud, light to moderate breeze, fine	5 hrs x 2 persons (0900–1400)
8/11/2023	Rock rolling and opportunistic diurnal threatened fauna census	Reptiles	17°C, 4/8 cloud, light to moderate breeze, fine	1 hr x 2 persons (0700–0800)
8/11/2023	Diurnal census for threatened fauna, Scat Search using Spot assessment technique (SAT)	Birds and mammals	18–29°C, 8/8 cloud, light to moderate breeze, fine with storm approaching in late afternoon	8 hrs x 2 persons (0800–1600)
9/11/2023	Rock rolling and opportunistic diurnal threatened fauna census	Reptiles	17°C, 4/8 cloud, calm, fine	2 hrs x 2 persons (0600–0800)
9/11/2023	Diurnal census for threatened fauna, Scat Search using Spot assessment technique (SAT)	Birds and mammals	17–30°C, 4/8 cloud, calm, fine	7.5 hrs x 2 persons (0800–1530)
10/11/2023	Rock rolling and diurnal census for threatened fauna	Reptiles	14°C, foggy, calm, fine	1.75 hrs x 2 persons (0645–0830)
16/11/2023	Diurnal census for threatened fauna and habitat mapping of rocky outcrops / habitats	Bird census and habitat mapping for bats and mammals	30–25°C, 0/8 cloud, calm, fine	2 hrs x 2 persons (1400–1600)
17/11/2023	Rock rolling and diurnal census for threatened fauna	Reptiles	18°C, 1/8 cloud, calm, fine	1.5 hrs x 2 persons (0630–0800)
Total Diurnal Survey Effort				108.5 person hours over 14 days

2.4.4.2 Nocturnal Fauna Surveys

Nocturnal fauna species were targeted during spotlighting surveys undertaken on the dates listed in **Table 2.8** and survey locations are mapped in **Figure 2.7**, **Figure 2.8** and **Figure 2.9A–D**.

Table 2.8 Details of Nocturnal Threatened Fauna Surveys Completed

Survey Date	Survey Method	Threatened fauna groups targeted	Weather conditions	Survey effort
9/08/2023	Spotlighting from vehicle along roadside	Mammals and nocturnal birds	6–10°C, no wind, no cloud, no rain, no moon	2 hrs x 2 people (1900–2100)
10/08/2023	Spotlighting from vehicle along roadside	Mammals and nocturnal birds	10–16°C, light breeze, no rain, no moon	2 hrs x 2 people (1900–2100)
7/11/2023	Spotlighting from vehicle and on foot along roadside	Mammals and nocturnal birds	25°C, 0/8 cloud, calm, fine, no moon	4.5 hrs x 2 people (1900–2330)
Total Nocturnal Fauna Survey Effort				8.5 hours over 3 nights

2.4.4.3 Remote Detection Fauna Surveys

Remote baited cameras surveys were undertaken for arboreal and terrestrial mammal species as documented in **Table 2.9** and mapped in **Figure 2.7**, **Figure 2.8** and **Figure 2.9A–D**. Camera trapping was completed with 243 trap nights achieved using 16 cameras (cameras mounted on trees with 14 mounted at approximately 1.5 m height and 2 mounted at <0.5 m height), during the first three weeks of November 2023. Camera trap lures consisted of a weatherproof bait cannister loosely packed with a sticky rolled oats, honey and peanut butter mixture, mounted on trees sprayed liberally with a honey-water mixture.

Table 2.9 Details of Remote Detection Fauna Surveys Completed

Survey Date	Survey Method	Threatened fauna groups targeted	Weather conditions	Survey Effort
1/11/2023 to 16/11/2023	Baited arboreal camera traps (mounted on trees at 1.5 m)	Arboreal mammals	Variable (Average Min. Temp. = 12°C, Average Max. Temp. = 30°C, Days with any rainfall = 5, Total rainfall = 23.8 mm, maximum daily rainfall = 12.6 mm)*	210 camera trap nights (15 nights x 14 cameras)
1/11/2023 to 16/11/2023	Baited terrestrial camera traps (mounted on trees at <0.5 m)	Terrestrial mammals	Variable (Average Min Temp. = 12°C, Average Max Temp. = 30°C, Days with any rainfall = 5, Total rainfall = 23.8 mm, maximum daily rainfall = 12.6 mm)*	30 camera trap nights (15 nights x 2 cameras)

* Based on records from Merriwa Weather Station.



1:2,750
Scale at A4

- Legend**
- Road
 - ▭ Development Footprint
 - Waterbodies
 - Arboreal Baited Camera Traps
 - Mammal Scat Search Locations (SPOT Assessment Technique)

- | | |
|------------------------------|------------------------------|
| Spotlighting Transect | Rock Rolling Transect |
| — 9/11/2023 | — 31/10/2023 |
| | — 01/11/2023 |
| | — 02/11/2023 |
| | — 08/11/2023 |
| | — 16/11/2023 |

GDA 1994 MGA Zone 56

FIGURE 2.7
Threatened Fauna Survey Locations - Golden Highway Intersection Upgrade Development Footprint



1:15,000
Scale at A4

0 0.1 0.2 Kilometres

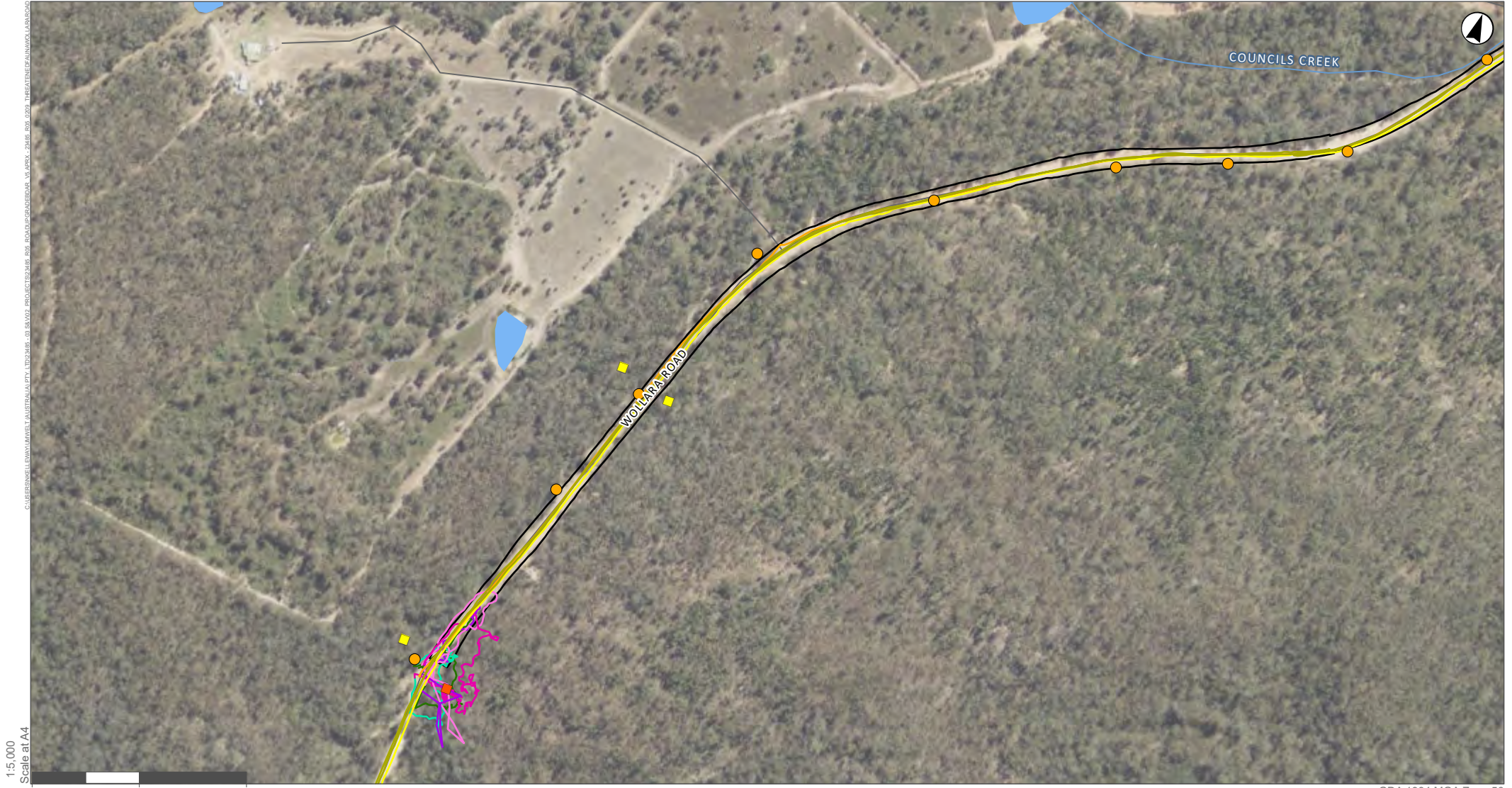
Legend

- Road
- Watercourse
- ▭ Development Footprint
- Waterbodies
- Arboreal Baited Camera Traps
- Mammal Scat Search Locations (SPOT Assessment Technique)

- | Spotlighting Transect | Rock Rolling Transect |
|-----------------------|-----------------------|
| — 09/08/2023 | — 01/11/2023 |
| — 10/08/2023 | — 02/11/2023 |
| — 07/11/2023 | — 07/11/2023 |
| | — 08/11/2023 |
| | — 16/11/2023 |

GDA 1994 MGA Zone 56

FIGURE 2.8
Threatened Fauna Survey Locations - Bow River to Binks Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - ▭ Development Footprint
 - Waterbodies
 - Arboreal Baited Camera Traps
 - Terrestrial Baited Camera Traps
 - Mammal Scat Search Locations (SPOT Assessment Technique)
- | Spotlighting Transect | Rock Rolling Transect |
|-----------------------|-----------------------|
| — 09/08/2023 | — 01/11/2023 |
| — 10/08/2023 | — 02/11/2023 |
| — 07/11/2023 | — 08/11/2023 |
| | — 09/11/2023 |
| | — 16/11/2023 |

FIGURE 2.9A
Threatened Fauna Survey Locations - Wollara Road Upgrade Development Footprint

Image Source: ESRI Basemap (2022) Data source: NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022)



1:5,000
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Road
- Watercourse
- Development Footprint
- Waterbodies
- Arboreal Baited Camera Traps
- Mammal Scat Search Locations (SPOT Assessment Technique)

Spotlighting Transect

- 09/08/2023
- 10/08/2023
- 07/11/2023

FIGURE 2.9B
Threatened Fauna Survey Locations - Wollara Road Upgrade Development Footprint



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - ▭ Development Footprint
 - Waterbodies
 - Arboreal Baited Camera Traps
 - Mammal Scat Search Locations (SPOT Assessment Technique)

- Spotlighting Transect**
- 09/08/2023
 - 10/08/2023
 - 07/11/2023

FIGURE 2.9C
Threatened Fauna Survey Locations - Wollara Road Upgrade Development Footprint



Legend

- Road
- ▭ Development Footprint
- Waterbodies
- Arboreal Baited Camera Traps
- Terrestrial Baited Camera Traps
- Mammal Scat Search Locations (SPOT Assessment Technique)

Spotlighting Transect

- 09/08/2023
- 10/08/2023
- 07/11/2023

FIGURE 2.9D

Threatened Fauna Survey Locations - Wollara Road Upgrade Development Footprint

2.5 Threatened Fungi

No threatened fungi species were identified as predicted or candidate threatened species.

2.6 Weather Conditions

The surveys undertaken were completed during suitable weather conditions. The weather conditions during fauna surveys are listed in **Section 4.0, Table 2.8** and **Table 2.9**.

2.7 Limitations

The surveys completed were undertaken where possible during the appropriate seasons specified within the TBDC to maximise the probability of detection. Where surveys were not able to be completed during the appropriate seasonal period for candidate threatened species, as assessment based on assumed presence was made.

3.0 Site Context

3.1 Assessment Area and Type

The Development Footprint occurs within the following IBRA Subregions:

- Liverpool Range.
- Kerrabee.

The Development Footprint assessed in this Report is a linear-shaped proposal and require assessment of habitat suitability for each IBRA subregion separately in accordance with Section 5.2(7) of the BAM. This is achieved using a separate Assessment Area and BAM-C case for each of the two IBRA Subregions identified above.

The Liverpool Range IBRA Subregion Assessment Areas, including the Development Footprint and the area of land within the 500 m buffer zones surrounding the Development Footprint is shown on the Location Maps in **Figure 1.3A–D**.

The Kerrabee IBRA Subregion Assessment Area, including the Development Footprint and the area of land within the 500 m buffer zone surrounding the Development Footprint is shown on the Location Map in **Figure 1.4A–B**.

3.2 Landscape Features

Landscape features identified within the Development Footprint are shown on the Site Maps provided as **Figure 1.1A–D** and **Figure 1.2A–B** and landscape features in the assessment areas are shown on the Location Maps provided as **Figure 1.3A–D** and **Figure 1.4A–B**. Further information on landscape features is provided in **Section 3.2.1** to **Section 3.2.7**.

3.2.1 IBRA Bioregions and IBRA Subregions

The Development Footprint is located within the Liverpool Range IBRA subregion which forms part of the Brigalow Belt South IBRA bioregion and within the Kerrabee IBRA subregion which forms part of the Sydney Basin IBRA Bioregion.

3.2.2 Rivers, Streams, Estuaries and Wetlands

The locations of the streams within the Development Footprint are shown on the Site Maps, provided as **Figure 1.1A–D** and **Figure 1.2A–D** and the locations of streams and rivers within the Assessment Area are shown on the Location Maps, provided as **Figure 1.3A–D** and **Figure 1.4A–B**.

The Ringwood Road culvert upgrade areas cross Killoe Creek which is a 4th order watercourse and Bow River which is a 5th order watercourse. The Wollara Road upgrade area crosses 1st, 2nd and 3rd order tributaries of Council's Creek. There are watercourses within the Golden Highway upgrade area.

The watercourses which intersect the Development Footprint are all part of the Goulburn River catchment. There are no estuaries or wetlands located within the Development Footprint.

3.2.3 Habitat Connectivity

The proposed Ringwood Road and Golden Highway upgrade areas predominantly adjoin degraded rural areas. There is some remnant scattered canopy tree vegetation which provides potential habitat connectivity points, however the surrounding land has been predominantly cleared for agricultural use.

The proposed Wollara Road upgrade areas adjoin intact habitat within the Tongo State Forest and within private properties to the south with a mix of fragmented agricultural land consisting predominantly of grazing native pastures and intact forest vegetation to the north.

All of the proposed Development Footprint assessed within this report have already been fragmented by existing road corridors and the proposed works are not likely to result in any additional significant impacts to habitat connectivity. Whilst the road footprint is being widened, the road will retain close proximity to canopy trees, which will continue to facilitate wildlife movement (i.e. microbats, woodland birds, and gliding mammals).

It is expected that the proposed upgraded road surface and sight lines will contribute to improved road safety for both road users and wildlife by removing the risks and road hazards associated with unsealed roads.

3.2.4 Karst, Caves, Crevices, Cliffs, Rocks or Other Geological Features of Significance

No karst, caves, crevices, cliffs or geological features of significance were observed within the Development Footprint.

Field surveys have identified the presence of some areas of exposed excavated rock, natural surface rock and small areas of sandstone outcropping along the edge of the existing road reserve, particularly in the Kerrabee IBRA Subregion Assessment Area.

3.2.5 Areas of Outstanding Biodiversity Value

The Development Footprint and Assessment Areas do not contain any areas of outstanding biodiversity value, as identified under the BC Act.

3.2.6 NSW (Mitchell) Landscapes

NSW Mitchell Landscapes are addressed below separately for the two IBRA subregions.

3.2.6.1 Liverpool Range IBRA Subregion

Within this IBRA Subregion the Development Footprint contains following NSW Mitchell Landscapes:

- Goulburn River Channels and Floodplains.
- Liverpool Range Valleys and Foothills.

The Liverpool Range Valleys and Foothlopes Mitchell Landscape was selected for assessment as it most accurately reflects the floristics and basalt geology of the impact areas which currently contain native vegetation. The Goulburn River Channels landscape is associated with Killoe Creek and Bow River, is predominantly cleared of native vegetation and forms only a minor part of the overall impact area.

3.2.6.2 Kerrabee IBRA Subregion

Within this IBRA Subregion the Development Footprint Area is located within the following NSW Mitchell Landscapes:

- Lees Pinch Foothills.
- Liverpool Range Valleys and Foothlopes.

The Lees Pinch Foothills was selected for the assessment as it most accurately reflects the impact areas assessed in relation to both floristics and the underlying sandstone geology. Areas mapped as the Liverpool Range Valleys and Foothlopes Mitchell Landscape are limited to the north-eastern parts of the Wollara Road Upgrade Development Footprint Area which is only marginally within the boundary of this Mitchell Landscape type.

3.2.7 Additional Landscape Features Identified in the SEARS

There are no specific additional landscape features identified for assessment in the SEARS.

3.3 Native Vegetation Cover

The native vegetation cover within the Assessment Areas was determined through site surveys of the Development Footprint and aerial photograph interpretation using ArcMap software and Six Maps aerial imagery dated 31 December 2008 and 14 April 2011. The mapping was also informed by reference to the Landuse Mapping for NSW 2017 V1.5 Dataset (DPE 2023e) which assisted in refining the previous native vegetation cover mapping undertaken.

Table 3.1 summarises the extent of native vegetation cover within the assessment areas and **Figure 1.3A–D** and **Figure 1.4A–B** show the extent of native vegetation cover within the assessment areas.

Table 3.1 Native Vegetation Cover in the Assessment Circle

Native Vegetation Cover	
Liverpool Range IBRA Subregion Cover Class (0–10, >10–30, >30–70 or >70 %)	42.1% (>30–70%)
Kerrabee IBRA Subregion Cover Class (0–10, >10–30, >30–70 or >70 %)	94.4% (>70% class)

4.0 Native Vegetation, Threatened Ecological Communities and Vegetation Integrity

4.1 Native Vegetation Extent

The parts of the Development Footprint assessed as native vegetation for the purposes of the vegetation integrity surveys are shown in **Figure 4.1A–F**, **Figure 4.2A–C**.

4.1.1 Changes to the Mapped Native Vegetation Extent

No changes were observed during surveys to the mapped native vegetation extent visible on the aerial imagery utilised for this assessment.

4.1.2 Areas That Are Not Native Vegetation

Areas of non-native vegetation mapped were limited to areas of bare ground such as the road surface. Other areas of exotic dominated vegetation were interspersed with low levels of native species and were assessed as native vegetation, using the benchmarks for PCT 483 in BAM-C.



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Waterbodies
 - Cleared Land
 - Native Vegetation Cover
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream

FIGURE 4.1A
Liverpool Range IBRA Subregion
Native Vegetation Extent

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - IBRA Region/Subregion
 - Development Footprint
 - Cleared Land
 - Exotic Vegetation
 - Native Vegetation Cover

GDA 1994 MGA Zone 56

FIGURE 4.1B
Liverpool Range IBRA Subregion
Native Vegetation Extent



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Cleared Land
 - Exotic Vegetation
 - Native Vegetation Cover
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 4th Order Stream

FIGURE 4.1C
Liverpool Range IBRA Subregion
Native Vegetation Extent

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Cleared Land
 - Exotic Vegetation
 - Native Vegetation Cover
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream

FIGURE 4.1D
Liverpool Range IBRA Subregion
Native Vegetation Extent

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Cleared Land
 - Exotic Vegetation
 - Native Vegetation Cover
- Stream Order**
- 2nd Order Stream
 - 5th Order Stream or Higher

FIGURE 4.1E
Liverpool Range IBRA Subregion
Native Vegetation Extent

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:3,500
Scale at A4

Legend

- Road
- Property Boundaries
- IBRA Region/Subregion
- Development Footprint
- Waterbodies
- Cleared Land
- Exotic Vegetation
- Native Vegetation Cover
- Stream Order**
- 1st Order Stream

GDA 1994 MGA Zone 56

FIGURE 4.1F
Liverpool Range IBRA Subregion
Native Vegetation Extent



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - Waterbodies
 - Cleared Land
 - Native Vegetation Cover
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream

GDA 1994 MGA Zone 56

FIGURE 4.2A
Kerrabee IBRA Subregion Native
Vegetation Extent



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - Waterbodies
 - Cleared Land
 - Native Vegetation Cover
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream

GDA 1994 MGA Zone 56

FIGURE 4.2B
Kerrabee IBRA Subregion Native
Vegetation Extent



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Waterbodies
 - Cleared Land
 - Native Vegetation Cover
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream

FIGURE 4.2C
Kerrabee IBRA Subregion Native
Vegetation Extent

4.2 Plant Community Types

4.2.1 Liverpool Range IBRA Subregion Assessment Area Vegetation Condition Zones & PCT Overview

The vegetation within the Development Footprint for the Liverpool Range Assessment Area has been assessed as aligning with the BioNet Vegetation Classification PCTs identified within **Table 4.1**. The extent of each of these PCTs is shown in **Figure 4.3A–F**. Detailed descriptions of each PCT for this Assessment Area are provided in **Section 4.2.2**. It is noted that the PCTs available for the Liverpool Range Assessment Area are not subject to the Revised PCTs for Eastern NSW (coast and tablelands regions) Classification (DPE 2023d).

Table 4.1 Plant Community Types Identified within the Liverpool Range Assessment Area Development Footprint

Vegetation Condition Zone	PCT ID	PCT name	Vegetation Formation	Vegetation Class	NSW PCT Percentage Cleared Estimate	Plots Completed	Area (ha)
1 – PCT 483 Remnant Trees	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Grassy Woodlands	Western Slopes Grassy Woodlands	90 %	3 Plots <ul style="list-style-type: none"> Plot 2 Plot 11 Plot 12. 	0.20
2 – Exotic Dominated Derived Grassland (assessed against PCT 483)	483*	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley*	Grassy Woodlands	Western Slopes Grassy Woodlands	90 %	3 Plots <ul style="list-style-type: none"> Plot 1 Plot 3 Plot 4. 	3.12
3 – PCT 1691 Roadside Remnant Forest	1691	Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter	Grassy Woodlands	Coastal Valley Grassy Woodlands	77 %	1 Plot <ul style="list-style-type: none"> Plot 10. 	0.09
* Vegetation condition zone identified as original PCT from which the derived vegetation has likely developed as per BAM S4.2.							



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - Development Footprint
 - Waterbodies
 - Watercourse**
 - Watercourse
 - Impact Areas**
 - Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 4.3A
Liverpool Range IBRA Subregion PCT and
Vegetation Condition Zone Map

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

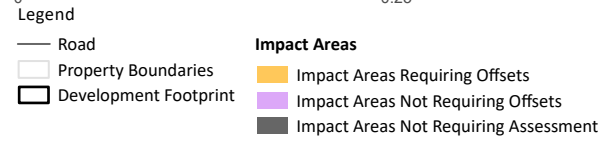


FIGURE 4.3B
 Liverpool Range IBRA Subregion PCT and
 Vegetation Condition Zone Map



1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - Development Footprint
 - Watercourse**
 - Watercourse
 - Impact Areas**
 - Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 4.3C
Liverpool Range IBRA Subregion PCT and
Vegetation Condition Zone Map

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - Development Footprint
 - Watercourse**
 - Watercourse
 - Impact Areas**
 - Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 4.3D
Liverpool Range IBRA Subregion PCT and
Vegetation Condition Zone Map

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - Development Footprint
 - Watercourse**
 - Watercourse
 - Impact Areas**
 - Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

GDA 1994 MGA Zone 56

FIGURE 4.3E
Liverpool Range IBRA Subregion PCT and
Vegetation Condition Zone Map



1:3,500
Scale at A4

Legend

- | | | |
|-----------------------|--------------------|---------------------------------------|
| Road | Watercourse | Impact Areas |
| Property Boundaries | Watercourse | Impact Areas Requiring Offsets |
| Development Footprint | | Impact Areas Not Requiring Offsets |
| Waterbodies | | Impact Areas Not Requiring Assessment |

GDA 1994 MGA Zone 56

FIGURE 4.3F
Liverpool Range IBRA Subregion PCT and
Vegetation Condition Zone Map


4.2.2 Liverpool Range IBRA Subregion Assessment Area Vegetation Condition Zones & PCT Descriptions

4.2.2.1 PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

Vegetation Condition Zone 1 PCT 483 Remnant Trees

The characteristics of Vegetation Condition Zone 1 are described in **Table 4.2**.

Table 4.2 Description of Vegetation Condition Zone 1 PCT 483 Remnant Trees

Vegetation Condition Zone	Vegetation Condition Zone 1 - PCT 483 Remnant Trees
PCT Name	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley
BAM C PCT Number	483
Total Area (ha)	0.20 ha
Plots Completed	3 Plots <ul style="list-style-type: none"> • Plot 12 • Plot 2 • Plot 11.
Formation	Grassy Woodlands
Class	Western Slopes Grassy Woodlands
Photo	


Vegetation Condition Zone	Vegetation Condition Zone 1 - PCT 483 Remnant Trees
PCT Name	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley
Location	The Remnant Trees Vegetation Condition Zone occurs primarily as scattered remnant trees and trees on the edges of larger woodland patches within the Golden Highway Intersection Upgrade and Killoe Creek to Binks Road Upgrade Development Footprint.
Canopy Description	The canopy of the Remnant Trees vegetation condition zone is characterised by <i>Eucalyptus melliodora</i> with scattered occurrences of <i>Eucalyptus albens</i> x <i>moluccana</i> and <i>Angophora floribunda</i> .
Mid-storey Description	The mid-storey is very sparse or absent and consisted of <i>Eremophila debilis</i> and <i>Pimelea latifolia</i> .
Ground Cover Description	The groundcover is dominated by native and exotic grasses including the native <i>Aristida ramosa</i> and the exotic grasses <i>Hyparrhenia hirta</i> , <i>Bromus catharticus</i> and <i>Avena sativa</i> . There are low densities of native herbs and forbs, particularly in the Remnant Trees vegetation condition zone areas. Species of native herbs and forbs observed include <i>Calotis lappulacea</i> , <i>Dichondra repens</i> , <i>Einadia hastata</i> and <i>Geranium solanderi</i> .
Introduced Species	Exotic cover was very high in the ground layer of this PCT. Dominant species included <i>Sonchus oleraceus</i> , <i>Hyparrhenia hirta</i> , <i>Bromus catharticus</i> and <i>Avena sativa</i> .
PCT Allocation Justification	<p>General Description from NSW BioNet Vegetation Classification:</p> <p>PCT 483 is described in the BioNet Vegetation Classification as being a mid-high to tall open woodland or woodland dominated by a Grey Box (<i>Eucalyptus moluccana</i>) x White Box (<i>Eucalyptus albens</i>) hybrid. Few other tree species are described as occurring, with Rough-barked Apple (<i>Angophora floribunda</i>) and Yellow Box (<i>Eucalyptus melliodora</i>) identified as occurring on footslopes and valley flats (DPE 2023c). These three tree species were all observed within the Remnant Trees Vegetation Condition Zone.</p> <p>Location:</p> <p>This PCT is described in the BioNet Vegetation Classification as occurring on brown to black earth, chocolate loam to clay soils derived from basalt on hillslopes, hillcrests, footslopes and valley flats on rolling hills and low hills on the Merriwa Plain and lower southern slopes of the Liverpool Range in the upper Hunter Valley in the far south-eastern corner of the Brigalow Belt South Bioregion (DPE 2023c). This part of the Development Footprint is located on the Merriwa Plain in the south-easter corner of the Brigalow Belt South Bioregion.</p> <p>Community structure:</p> <p>PCT 483 is described in the BioNet Vegetation Classification as a grassy woodland (DPE 2023c). The areas assigned to this PCT and Vegetation Condition Zone are a disturbed variation of the original grassy woodland vegetation structure.</p> <p>Species assemblage:</p> <p>Characteristic canopy species for this PCT were observed, including Grey Box (<i>Eucalyptus moluccana</i>) x White Box (<i>Eucalyptus albens</i>) hybrid, Rough-barked Apple (<i>Angophora floribunda</i>) and Yellow Box (<i>Eucalyptus melliodora</i>). No non-characteristic species were recorded.</p> <p>The characteristic shrub species including <i>Eremophila debilis</i> were observed.</p> <p>Characteristic groundcovers observed include <i>Austrostipa aristiglumis</i>, <i>Cynodon dactylon</i>, <i>Calotis lappulacea</i>, <i>Einadia nutans</i> and <i>Geranium solanderi</i>.</p>

Vegetation Condition Zone	Vegetation Condition Zone 1 - PCT 483 Remnant Trees
PCT Name	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley
	<p>Other PCTs considered:</p> <p>The following other PCTs mapped in the State Vegetation Type Mapping within the locality were also considered:</p> <ul style="list-style-type: none"> • PCT 1693 Yellow Box - Rough-barked Apple grassy woodland of the upper Hunter and Liverpool Plains • PCT 1695 Yellow Box grassy woodland on basalt soils of the upper Hunter • PCT 1696 Blakely's Red Gum - Rough-barked Apple shrubby woodland of central and upper Hunter. <p>PCTs 1693 and 1695 were excluded as they do not contain <i>Eucalyptus moluccana</i>, <i>Eucalyptus albens</i> or the intergrade between these species, which whilst not recorded in plots sampled, are present as scattered trees within the Development Footprint and adjoining land. PCT 1693 is described as typically occurring on unconsolidated sediments which are not strongly associated with the areas of remnant vegetation observed.</p> <p>PCT 1696 was excluded due to the lack of <i>Eucalyptus blakelyi</i> and <i>Eucalyptus crebra</i>.</p>
BC Act Status	This Vegetation Condition Zone corresponds with the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions Critically Endangered Ecological Community (CEEC) (refer to Figure 4.5 and Figure 4.6).
EPBC Act Status	<p>A subset of this Vegetation Condition Zone corresponds to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC. These areas include where groundcover vegetation is predominantly native or expected to be predominantly native across the patch and the criteria for the condition classes A, B or C identified in the Approved Conservation Advice (DCCEEW 2023a) are met or expected to be met given the limited access to patch areas outside of the Development Footprint.</p> <p>The areas of this Vegetation Condition Zone not mapped as corresponding to the EPBC Act-listed White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC do not have a predominantly native understorey (refer to Figure 4.5 and Figure 4.6).</p>

Vegetation Condition Zone 2 PCT 483 Exotic Dominated Grassland

The characteristics of Vegetation Condition Zone 2 are described in **Table 4.3**.

Table 4.3 Description of Vegetation Condition Zone 2 Exotic Dominated Derived Grassland

Vegetation Condition Zone	Vegetation Condition Zone 2 – Exotic Dominated Derived Grassland (assessed against PCT 483 Benchmarks)
PCT Name	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, Upper Hunter Valley
BAM C PCT Number	483
Total Area (ha)	3.12 ha
Plots Completed	3 Plots <ul style="list-style-type: none"> • Plot 1 • Plot 3 • Plot 4.
Formation	Grassy Woodlands (Benchmark formation)
Class	Western Slopes Grassy Woodlands (Benchmark class)
Photo	
Location	Areas of exotic dominated grassland occur extensively in the historically cleared parts of the Killoe Creek to Binks Road Development Footprint Area and the Golden Highway Intersection Development Footprint Area.
Canopy Description	Absent
Mid-storey Description	Absent
Ground Cover Description	The groundcover is dominated by exotics including <i>Bromus catharticus</i> , <i>Paspalum dilatatum</i> , <i>Cirsium vulgare</i> , <i>Avena sativa</i> , <i>Sonchus oleraceus</i> , <i>Hyparrhenia hirta</i> , <i>Cenchrus clandestinus</i> and <i>Phalaris aquatica</i> .
Introduced Species	As above.
PCT Allocation Justification	This Vegetation Condition Zone has been assigned to the original PCT from which the derived vegetation has likely developed as per BAM S4.2 for the purposes of assessment against a PCT benchmark, noting that many areas contain no or very few native flora species.

Vegetation Condition Zone	Vegetation Condition Zone 2 – Exotic Dominated Derived Grassland (assessed against PCT 483 Benchmarks)
PCT Name	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, Upper Hunter Valley
BC Act Status	The potential for this vegetation condition zone to correspond to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions CEEC, as listed under the BC Act, was considered. Floristic plot surveys have identified that this vegetation condition zone is dominated by exotic groundcovers and does not comprise a derived native grassland.
EPBC Act Status	The potential for this vegetation condition zone to correspond to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC, as listed under the EPBC Act, was considered. This vegetation condition zone is considered to not correspond to the listed community, as it is dominated by exotic groundcovers and does not meet the condition class requirements of the Approved Conservation Advice for this CEEC (DCCEEW 2023a) which requires the presence of a predominantly native understorey.


4.2.2.2 PCT 1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter

Vegetation Condition Zone 3 PCT 1691 Roadside Remnant Forest

The characteristics of Vegetation Condition Zone 3 are described in **Table 4.4**.

Table 4.4 Description of Vegetation Condition Zone 3 PCT 1691 Roadside Remnant Forest

Vegetation Condition Zone	Vegetation Condition Zone 3 - PCT 1691 Roadside Remnant Forest
PCT Name	Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter
BAM C PCT Number	1691
Total Area (ha)	0.09 ha
Plots Completed	1 Plot <ul style="list-style-type: none"> Plot 10.
Formation	Grassy Woodlands
Class	Coastal Valley Grassy Woodlands

Vegetation Condition Zone	Vegetation Condition Zone 3 - PCT 1691 Roadside Remnant Forest
PCT Name	Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter
Photo	
Location	This vegetation condition zone occurs in the parts of the Wollara Road Upgrade Development Footprint Area which occurs within the Liverpool Ranges IBRA Subregion and occurs in areas associated with the Liverpool Ranges Valleys and Foothlopes NSW Mitchell Landscape. These areas are mapped on Banks Wall Sandstone, however are located downslope of areas mapped on the Liverpool East Basalt rock unit.
Canopy Description	The canopy of the Remnant Trees Vegetation Condition Zone is characterised by <i>Eucalyptus albens x moluccana</i> with occasional occurrences of <i>Brachychiton populneus</i> . <i>Eucalyptus crebra</i> was also observed in adjoining areas but not recorded within the plots sampled.
Mid-storey Description	Scattered shrubs are present in the mid-storey which is composed of species such as <i>Acacia linifolia</i> , <i>Acacia liniariifolia</i> , <i>Acacia dealbata</i> , <i>Notelaea macrocarpa</i> and <i>Eremophila debilis</i> .
Ground Cover Description	The groundcover is dominated by grasses including the native <i>Themeda triandra</i> , <i>Austrostipa scabra</i> , <i>Austrostipa verticillata</i> , <i>Anthosachne scabra</i> and <i>Bothriochloa macra</i> . There were typically low levels of forbs present including <i>Chrysocephalum apiculatum</i> , <i>Dichondra repens</i> and <i>Stellaria pungens</i> .
Introduced Species	Exotic cover was very low and typically limited to the ground layer of this Vegetation Condition Zone. Species observed included <i>Plantago lanceolata</i> and <i>Eragrostis curvula</i> .
PCT Allocation Justification	<p>General Description from NSW BioNet Vegetation Classification:</p> <p>PCT 1691 is described in the BioNet Vegetation Classification as a eucalypt woodland with a sparse mid-stratum composed of tall shrubs (DPE 2023c). The ground stratum is identified as the prominent understorey and is typically grassy with scattered forbs.</p> <p>Location:</p> <p>This PCT is described in the BioNet Vegetation Classification as occurring across the upper Hunter Valley and adjacent low hills from Broke west to Merriwa and north to above Scone, including the Liverpool Range IBRA Subregion and the Lees Pinch Foothills and Liverpool Range Valleys and Foothlopes NSW Mitchell Landscapes (DPE 2023c). It typically occurs on coal-bearing sedimentary at elevations between 70 and 350 m. The BioNet Vegetation Classification also identifies the presence of <i>E. moluccana</i> intergrades with <i>E. albens</i>.</p>

Vegetation Condition Zone	Vegetation Condition Zone 3 - PCT 1691 Roadside Remnant Forest
PCT Name	Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter
	<p>Community structure:</p> <p>PCT 483 is described in the BioNet Vegetation Classification as a grassy woodland. This description corresponds with the areas assigned to this PCT.</p> <p>Species assemblage:</p> <p>Characteristic canopy species for this PCT were observed, including Grey Box (<i>Eucalyptus moluccana</i>) x White Box (<i>Eucalyptus albens</i>), Kurrajong (<i>Brachychiton populneus</i>) and Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>).</p> <p>The characteristic shrub species <i>Notelaea microcarpa</i> (Native Olive) was observed.</p> <p>Characteristic groundcovers observed include <i>Eremophila debilis</i>, <i>Dichondra repens</i> and <i>Aristida ramosa</i>.</p> <p>Other PCTs considered:</p> <p>PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley was considered however was discounted due to the lack of <i>Eucalyptus crebra</i> in the canopy and alignment with the presence of PCT 1691 on the State Vegetation Type Map where this vegetation occurs.</p>
BC Act Status	This Vegetation Condition Zone corresponds with the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions CEEC listed under the BC Act.
EPBC Act Status	This Vegetation Condition Zone corresponds with the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native CEEC listed under the EPBC Act.

4.2.3 Kerrabee IBRA Subregion Assessment Area Vegetation Condition Zones & PCT Overview

The vegetation within the Development Footprint Area for the Kerrabee IBRA Subregion Assessment Area has been assessed as aligning with the BioNet Vegetation Classification PCTs identified within **Table 4.5**. The extent of these PCTs within the Development Footprint Area is mapped in **Figure 4.4A–C**. Detailed descriptions of each PCT are provided in **Section 4.2.4**. It is noted that the PCTs available for the Kerrabee IBRA Subregion Assessment Area are subject to the Revised PCTs for Eastern NSW (coast and tablelands regions) Classification.

Table 4.5 Plant Community Types Identified within the Kerrabee IBRA Subregion Assessment Development Footprint Area

Vegetation Condition Zone	PCT ID	PCT name	Vegetation Formation	Vegetation Class	NSW PCT Percentage Cleared Estimate	Plots Completed	Area (ha)
4 – PCT 3334 Roadside Remnant Forest	3334	Western Hunter Flats Red Gum Sedge Forest	Grassy Woodlands	Coastal Valley Grassy Woodlands	57.03 %	1 Plot • Plot 9.	0.04
5 – PCT 3388 Roadside Remnant Forest	3388	Central West Valleys White Box Forest	Grassy Woodlands	Western Slopes Grassy Woodlands	69.60 %	2 plots • Plot 6 • Plot 7.	0.36
6 – PCT 3781 Roadside Remnant Forest	3781	Ulan Sandstone Ironbark-Pine Woodland	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	46.25%	2 Plots • Plot 5 • Plot 8.	1.05



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
- Vegetation Condition Zones**
- Cleared Land - Road Surface
 - Zone 5 - PCT 3388 Roadside Remnant Forest
 - Zone 6 - PCT 3781 Roadside Remnant Forest

GDA 1994 MGA Zone 56

FIGURE 4.4A
Kerrabee IBRA Subregion PCT and
Vegetation Condition Zone Map

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
- Vegetation Condition Zones**
- Cleared Land - Road Surface
 - Zone 5 - PCT 3388 Roadside Remnant Forest
 - Zone 6 - PCT 3781 Roadside Remnant Forest

FIGURE 4.4B
Kerrabee IBRA Subregion PCT and
Vegetation Condition Zone Map



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Waterbodies
- Stream Order**
- - - 1st Order Stream
 - - - 2nd Order Stream
 - - - 3rd Order Stream
- Vegetation Condition Zones**
- Cleared Land - Road Surface
 - Zone 5 - PCT 3388 Roadside Remnant Forest
 - Zone 6 - PCT 3781 Roadside Remnant Forest

GDA 1994 MGA Zone 56

FIGURE 4.4C
Kerrabee IBRA Subregion PCT and
Vegetation Condition Zone Map


4.2.4 Kerrabee IBRA Subregion Assessment Area Vegetation Condition Zone PCT Descriptions

4.2.4.1 PCT 3334 Western Hunter Flats Red Gum Sedge Forest

Vegetation Condition Zone 4 PCT 3334 Roadside Remnant Forest

The characteristics of Vegetation Condition Zone 4 are described in **Table 4.6**.

Table 4.6 Description of Vegetation Condition Zone 4 PCT 3334 Roadside Remnant Forest

Vegetation Condition Zone	Vegetation Condition Zone 4 - PCT 3334 Roadside Remnant Forest
PCT Name	Western Hunter Flats Red Gum Sedge Forest
BAM C PCT Number	3334
Total Area (ha)	0.04 ha
Plots Completed	1 Plot <ul style="list-style-type: none"> Plot 9.
Formation	Grassy Woodlands
Class	Coastal Valley Grassy Woodlands
Photo	
Location	This PCT is represented by one Vegetation Condition Zone and is occurs at one location in association with a tributary of Council's Creek.
Canopy Description	The canopy is characterised by <i>Eucalyptus blakelyi</i> and <i>Angophora floribunda</i> . <i>Allocasuarina</i> is also present in the sub-canopy.
Mid-storey Description	The mid-storey is very sparse and includes <i>Cassinia sifton</i> and <i>Allocasuarina littoralis</i> .


Vegetation Condition Zone	Vegetation Condition Zone 4 - PCT 3334 Roadside Remnant Forest
PCT Name	Western Hunter Flats Red Gum Sedge Forest
Ground Cover Description	The groundcover is dominated by native grasses, graminoids and sedges including <i>Microlaena stipoides</i> , <i>Dichelachne crinita</i> , <i>Eragrostis brownii</i> , <i>Aristida ramosa</i> , <i>Juncus australis</i> , <i>Gahnia aspera</i> and <i>Gahnia sieberiana</i> .
Introduced Species	Exotic cover was low and confined to the ground layer of this PCT. Dominant species included <i>Lysimachia arvensis</i> , <i>Bromus catharticus</i> , <i>Juncus acutus</i> , <i>Oxalis pes-caprae</i> , <i>Plantago lanceolata</i> , <i>Cirsium arvense</i> and <i>Verbena bonariensis</i> .
PCT Allocation Justification	<p>General Description from NSW BioNet Vegetation Classification:</p> <p>PCT 3334 is described in the BioNet Vegetation Classification as having a tree canopy with a high cover of <i>Eucalyptus blakelyi</i> or rarely <i>Eucalyptus tereticornis</i>, commonly with <i>Angophora floribunda</i> (DPE 2023c). The mid-stratum is sometimes absent, however is more typically sparse with scattered shrubs. The ground layer almost always includes <i>Carex appressa</i>, with characteristic high cover, and the grass <i>Microlaena stipoides</i>. These are accompanied by a range of other sedge species or small forbs and grasses that prefer damp soils, commonly including include <i>Lachnagrostis filiformis</i> and <i>Hydrocotyle laxiflora</i>, occasionally with <i>Centella asiatica</i>. This PCT is found in the lowest rainfall districts of the western Hunter Valley, at elevations of 120–330 metres asl. It occurs in small linear areas or low-lying depressions within a mosaic of other alluvial forests in the region.</p> <p>Location:</p> <p>This PCT is described in the BioNet Vegetation Classification as occurring found on damp alluvial soils between Denman and Ulan, in the western Hunter catchment.</p> <p>Community structure:</p> <p>PCT 3334 is categorised in the BioNet Vegetation Classification as a grassy woodland and described as a tall to very tall sclerophyll open forest with a very sparse mid-stratum and a dense ground layer of sedges.</p> <p>Species assemblage:</p> <p>Characteristic canopy species for this PCT were observed, including Blakely's Red Gum (<i>Eucalyptus blakelyi</i>) and Rough-barked Apple (<i>Angophora floribunda</i>).</p> <p>Characteristic groundcovers observed include <i>Microlaena stipoides</i> and <i>Gahnia aspera</i>.</p> <p>Other PCTs considered:</p> <p>PCT 3528 Western Hunter Flats Apple-Gum Shrub Forest was considered however was excluded as <i>Angophora floribunda</i> is dominant in that community and subdominant within the Development Footprint Area and in the chosen PCT.</p> <p>PCT 3530 Western Hunter Sandy Riparian Gum Shrub Forest was considered and excluded based on the understorey species as PCT 3334 includes a greater diversity of sedges and higher cover of <i>Microlaena stipoides</i>, which more accurately represents the vegetation present.</p> <p>PCT 3403 Western Hunter Creekflat Apple Grassy Forest was considered and excluded as <i>Angophora floribunda</i> is dominant in that community and subdominant within the Development Footprint Area and in the chosen PCT.</p>
BC Act Status	This Vegetation Condition Zone does not correspond to any TECs listed under the BC Act.
EPBC Act Status	This Vegetation Condition Zone does not correspond to any TECs listed under the EPBC Act.

4.2.4.2 3388 Central West Valleys White Box Forest

Vegetation Condition Zone 5 PCT 3388 Roadside Remnant Forest

The characteristics of Vegetation Condition Zone 5 are described in **Table 4.7**.

Table 4.7 Description of Vegetation Condition Zone 5 PCT 3388 Roadside Remnant Forest

Vegetation Condition Zone	Vegetation Condition Zone 5 - PCT 3388 Roadside Remnant Forest
PCT Name	Central West Vallys White Box Forest
BAM C PCT Number	3388
Total Area (ha)	0.36 ha
Plots Completed	2 Plots <ul style="list-style-type: none"> Plot 6 Plot 7.
Formation	Grassy Woodlands
Class	Western Slopes Grassy Woodlands
Photo	
Location	This PCT occurs in the Disturbance Area in locations transitional between sandstone and basalt geology which have higher soil nutrient levels compared to surrounding areas with soils primarily derived from sandstone.
Canopy Description	The canopy is characterised primarily by <i>Eucalyptus crebra</i> with <i>Eucalyptus albens</i> <> <i>moluccana</i> present as a sub-dominant species. <i>Eucalyptus blakelyi</i> and <i>Brachychiton populneus</i> also occasionally occur.

Vegetation Condition Zone	Vegetation Condition Zone 5 - PCT 3388 Roadside Remnant Forest
PCT Name	Central West Vallys White Box Forest
Mid-storey Description	The mid-storey is sparse to shrubby in areas of previous disturbance and includes <i>Senna artemisioides zygophylla</i> , <i>Acacia linifolia</i> , <i>Acacia dealbata</i> , <i>Acacia linearifolia</i> and <i>Eremophila debilis</i> .
Ground Cover Description	The groundcover is dominated by native grasses particularly <i>Themeda triandra</i> , <i>Aristida ramosa</i> , <i>Chloris truncata</i> , <i>Austrostipa verticillata</i> and <i>Anthosachne scabra</i> .
Introduced Species	Exotic cover was low and confined to the ground layer of this PCT. Dominant species included <i>Opuntia</i> sp., <i>Plantago lanceolata</i> and <i>Eragrostis curvula</i> .
PCT Allocation Justification	<p>General Description from NSW BioNet Vegetation Classification:</p> <p>This PCT has a canopy almost always includes a high cover of <i>Eucalyptus albens</i>, with other Eucalypts only rarely present (DPE 2023c). The shrub layer is sparse and almost always includes one or more <i>Acacia</i> species, of which <i>Acacia implexa</i> is the most frequent and abundant, with scattered <i>Cassinia sifton</i> also occasionally present. The mid-dense ground layer is mainly comprised of grasses and forbs, with some graminoids, twiners, low growing shrubs and ground ferns. Very frequent ground layer species include <i>Austrostipa scabra</i>, <i>Aristida ramosa</i>, <i>Dichondra repens</i>, <i>Calotis lappulacea</i>, <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> and <i>Microlaena stipoides</i>.</p> <p>Location:</p> <p>This PCT occurs in valleys with a warm, dry environment with a mean annual rainfall typically below 700 mm on loamy soils that include a sandy component derived from nearby sandstone ranges. It is found on the undulating floor of valleys nestled among the sandstone ranges of the Central West Slopes, including the Goulburn River.</p> <p>Community structure:</p> <p>PCT 3388 is categorised in the BioNet Vegetation Classification as a tall sclerophyll open forest with a sparse mid-stratum with soft-leaved species and a mid-dense, grassy ground layer.</p> <p>Species assemblage:</p> <p>Within the Upper Hunter <i>Eucalyptus albens</i> and <i>Eucalyptus moluccana</i> frequently hybridise and both are characteristic for this community. Acacias characterise the mid-storey of the vegetation assigned to this PCT and the ground layer is dominated by characteristic grass species.</p> <p>Other PCTs considered:</p> <p>PCT 3532 Western Hunter Ironbark-Box Forest is considered to be floristically similar to the vegetation within the areas mapped as this PCT. For this assessment PCT 3532 was not selected primarily because there is no association listed in the BioNet Vegetation Classification or BAM-C to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC which is considered to occur here in transitional areas on sandstone geology with basalt influence.</p>
BC Act Status	This Vegetation Condition Zone corresponds with the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions CEEC listed under the BC Act.


Vegetation Condition Zone	Vegetation Condition Zone 5 - PCT 3388 Roadside Remnant Forest
PCT Name	Central West Vallys White Box Forest
EPBC Act Status	This Vegetation Condition Zone corresponds with the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC listed under the EPBC Act. Some areas contain shrub cover higher than the 30% threshold provided in the key diagnostic characteristics for the community which reflects areas of potential historical disturbance and a precautionary approach was taken in mapping and TEC determination for this PCT.

4.2.4.3 3781 Ulan Sandstone Ironbark-Pine Woodland

Vegetation Condition Zone 6 PCT 3781 Roadside Remnant Forest

The characteristics of Vegetation Condition Zone 6 are described in **Table 4.8**.

Table 4.8 Description of Vegetation Condition Zone 6 PCT 3781 Roadside Remnant Forest

Vegetation Condition Zone	Vegetation Condition Zone 6 - PCT 3781 Roadside Remnant Forest
PCT Name	Ulan Sandstone Ironbark Pine Woodland
BAM C PCT Number	3781
Total Area (ha)	1.09 ha
Plots Completed	2 Plots <ul style="list-style-type: none"> Plot 5 Plot 8.
Formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Class	Western Slopes Dry Sclerophyll Forests
Photo	
Location	This PCT occurs in the Wollara Road Upgrade Disturbance Area on low nutrient sandstone soils.

Vegetation Condition Zone	Vegetation Condition Zone 6 - PCT 3781 Roadside Remnant Forest
PCT Name	Ulan Sandstone Ironbark Pine Woodland
Canopy Description	The canopy is characterised primarily by <i>Eucalyptus crebra</i> with low densities of <i>Eucalyptus fibrosa</i> and <i>Eucalyptus punctata</i> . A sub-canopy of <i>Allocasuarina luehmannii</i> , <i>Allocasuarina littoralis</i> and <i>Callitris endlicheri</i> was also present.
Mid-storey Description	Within the plots sampled, the mid-storey was dominated by <i>Acacia triptera</i> , <i>Grevillea speciosa</i> , <i>Acacia linearifolia</i> , <i>Cassinia sifton</i> , <i>Cassinia quinquefaria</i> , <i>Styphelia tubiflora</i> , <i>Persoonia linearis</i> , <i>Isopogon dawsonii</i> , <i>Deyeuxia quadriseta</i> and <i>Acacia spectabilis</i> .
Ground Cover Description	The ground layer is generally sparse and shaded by the dense shrubby mid storey. Species observed include <i>Austrostipa scabra</i> , <i>Panicum effusum</i> , <i>Aristida vagans</i> , <i>Rytidosperma caespitosum</i> , <i>Anthosachne scabra</i> , <i>Chloris truncata</i> , <i>Macrozamia reducta</i> , <i>Pomax umbellata</i> , <i>Lepidosperma laterale</i> , <i>Gahnia aspera</i> , <i>Themeda triandra</i> , <i>Goodenia hederacea</i> , <i>Entolasia marginata</i> and <i>Aristida ramosa</i> .
Introduced Species	Exotic cover was low and confined to the ground layer of this PCT. Dominant species included <i>Plantago lanceolata</i> , <i>Sida rhombifolia</i> , <i>Senecio madagascariensis</i> , <i>Opuntia stricta</i> and <i>Verbena bonariensis</i> . Exotic species were more commonly encountered in areas adjacent to rural properties used for grazing.
PCT Allocation Justification	<p>General Description from NSW BioNet Vegetation Classification:</p> <p>The tree canopy very frequently includes a sparse cover of <i>Eucalyptus crebra</i> and <i>Callitris endlicheri</i>, occasionally accompanied or replaced by <i>Eucalyptus fibrosa</i> or rarely <i>Eucalyptus macrorhyncha</i> (DPE 2023c). Other occasional or rare eucalypts include <i>Eucalyptus dwyeri</i> and <i>Eucalyptus rossii</i>. Characteristic mid-stratum species include <i>Acacia linearifolia</i>, <i>Leucopogon muticus</i>, <i>Persoonia linearis</i>, <i>Astroloma humifusum</i>, <i>Brachyloma daphnoides</i> and <i>Styphelia triflora</i>. The sparse ground layer is comprised of hardy grasses, graminoids and small forbs, very frequently including <i>Pomax umbellata</i>, <i>Lomandra multiflora</i>, <i>Microlaena stipoides</i>, <i>Lomandra glauca</i> and <i>Aristida ramosa</i>.</p> <p>Location:</p> <p>Occurs almost exclusively on exposed low-relief quartz-rich Triassic sandstone ranges (Narrabeen sandstone) and conglomerates between Wollar and Ulan in the far western Hunter River catchment. This PCT occurs at mid-elevations across the very low rainfall zones of the western Hunter River catchment largely on Narrabeen sandstones and conglomerates. It is found on a range of exposed aspects on broad ridges and comparatively gentle slopes and occupies the driest climates of the Sydney Basin sandstone environments.</p> <p>Community structure:</p> <p>A tall, rarely very tall, ironbark and <i>Callitris</i> sclerophyll woodland or open forest with a dry shrubby mid-stratum</p> <p>Species assemblage:</p> <p><i>Eucalyptus crebra</i> is dominant with other characteristic sub-dominant species such as <i>Eucalyptus punctata</i> and <i>Eucalyptus fibrosa</i> with <i>Callitris endlicheri</i> present in the sub-canopy. Many of the characteristic mid-stratum species are present and the groundlayer is characterised by a sparse cover of hardy grasses, graminoides and small forbs.</p>

Vegetation Condition Zone	Vegetation Condition Zone 6 - PCT 3781 Roadside Remnant Forest
PCT Name	Ulan Sandstone Ironbark Pine Woodland
	<p>Other PCTs considered:</p> <p>This PCT shares moderate floristic association with PCT 3756, however <i>Callistris endlicheri</i> is almost always absent and there is greater dominance of <i>Eucalyptus punctata</i> and <i>Eucalyptus fibrosa</i>. PCT 3756 is also associated with rugged Permian and Jurassic sandstone ranges found to the west and north of Ulan, rather than Narrabeen Sandstone.</p> <p>PCT 3768 was also considered however was excluded due an absence of deeper sandy clay-loam soils in areas mapped as PCT 3781, absence of species such as <i>Corymbia trachyphloia</i> and <i>Notelaea microcarpa</i> and absence in the current State Vegetation Type Mapping for the adjoining areas.</p>
BC Act Status	Not listed
EPBC Act Status	Not listed

4.3 Threatened Ecological Communities

One threatened ecological community were observed within the Development Footprint during surveys. This was the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions CEEC, as listed under the BC Act and the EPBC Act.

Further details for this threatened ecological community are provided in **Table 4.9** and its extent within the Development Footprint is mapped in **Figure 4.5A–F** and **Figure 4.6A–C**. The alignment of this TEC with the PCTs observed is further discussed in **Section 4.2** of this Report.

Table 4.9 TECs within the Development Footprint

IBRA Subregion	TEC name	Profile ID (from TBDC)	Act and Listing Status	Associated PCTs and vegetation condition zones within the Development Footprint	VI Score	Area (h–)
Liverpool–Range	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	10837 / 20392	Critically Endangered Ecological Community Listed under the BC Act and EPBC Act	PCT 483 Vegetation Condition Zone 1 – Remnant Trees	86.1	BC Act = 0.20 EPBC Act = 0.16
				PCT 1691 Vegetation Condition Zone 3 – Roadside Remnant Forest	67.9	0.09
Kerrabee	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	10837 / 20392	Critically Endangered Ecological Community Listed under the BC Act and EPBC Act	PCT 3388 Vegetation Condition Zone 5 – Remnant Forest	51.8	0.36
BC Act Total Area						0.65
EPBC Act Total Area						0.61



1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - ▭ IBRA Region/Subregion
 - ▭ Development Footprint
 - Waterbodies

- Stream Order**
- - - 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream

GDA 1994 MGA Zone 56

FIGURE 4.5A
Liverpool Range IBRA Subregion Threatened Ecological Community Map



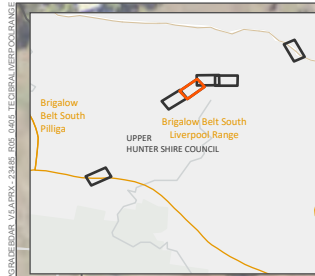
C:\USER\SMELLE\WORK\PROJECTS\IBRA\IBRA_PCT_483\PROJECTS\24\IBRA_PCT_483\IBRA_PCT_483_TERRAIN\IBRA_PCT_483

1:5,000
Scale at A4

- Legend**
- Road
 - Property Boundaries
 - IBRA Region/Subregion
 - Development Footprint

- Threatened Ecological Community**
- BC Act**
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

FIGURE 4.5B
Liverpool Range IBRA Subregion Threatened Ecological Community Map



1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

Legend

- Road
- Property Boundaries
- ▭ IBRA Region/Subregion
- ▭ Development Footprint
- Stream Order**
- - - 1st Order Stream

- 2nd Order Stream
- 4th Order Stream
- Threatened Ecological Community**
- BC Act**
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

- EPBC Act**
- ▨ PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

FIGURE 4.5C
Liverpool Range IBRA Subregion Threatened Ecological Community Map



1:5,000
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Road
- Property Boundaries
- IBRA Region/Subregion
- Development Footprint
- Stream Order**
- 1st Order Stream

- 2nd Order Stream
- Threatened Ecological Community**
- BC Act**
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

- EPBC Act**
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

FIGURE 4.5D
Liverpool Range IBRA Subregion Threatened Ecological Community Map



1:5,000
Scale at A4

Legend

- Road
- Property Boundaries
- IBRA Region/Subregion
- Development Footprint
- Stream Order**
- 2nd Order Stream

- 5th Order Stream or Higher
- Threatened Ecological Community**
- BC Act**
- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

GDA 1994 MGA Zone 56

FIGURE 4.5E
Liverpool Range IBRA Subregion Threatened Ecological Community Map



1:3,500
Scale at A4

Legend

- Road
- Property Boundaries
- IBRA Region/Subregion
- Development Footprint
- Waterbodies

Stream Order

- 1st Order Stream

Threatened Ecological Community

BC Act

- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

EPBC Act

- PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

GDA 1994 MGA Zone 56

FIGURE 4.5F
Liverpool Range IBRA Subregion Threatened Ecological Community Map



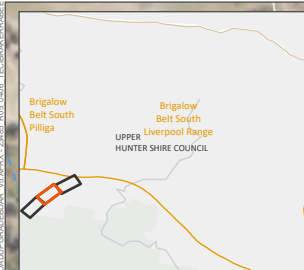
1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - ▭ Development Footprint
 - Waterbodies
 - Stream Order**
 - - - 1st Order Stream
 - 2nd Order Stream
 - Threatened Ecological Community**
 - BC Act**
 - PCT 3388 Central West Valleys White Box Forest
 - EPBC Act**
 - ▨ PCT 3388 Central West Valleys White Box Forest, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

4.6A
Kerrabee IBRA Subregion Threatened Ecological Community Map



1:5,000
Scale at A4



GDA 1994 MGA Zone 56

Legend

- Road
- Property Boundaries
- Development Footprint
- Waterbodies
- Stream Order**
- 1st Order Stream

- 2nd Order Stream
- 3rd Order Stream
- Threatened Ecological Community**
- BC Act**
- PCT 3388 Central West Valleys White Box Forest

- EPBC Act**
- PCT 3388 Central West Valleys White Box Forest, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

4.6B
Kerrabee IBRA Subregion Threatened Ecological Community Map



1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Property Boundaries
 - IBRA Region/Subregion
 - Development Footprint
 - Waterbodies
- Stream Order**
- 1st Order Stream
 - 2nd Order Stream
 - 3rd Order Stream
- Threatened Ecological Community**
- BC Act**
- PCT 3388 Central West Valleys White Box Forest
- EPBC Act**
- PCT 3388 Central West Valleys White Box Forest, White Box-Yellow Box-Blakely's Red Gum

4.6C
Kerrabee IBRA Subregion Threatened Ecological Community Map

4.4 Vegetation Condition Zones

A description of each vegetation condition zone within the Development Footprint is provided in **Section 4.2** of this Report. The vegetation condition zones are mapped in **Figure 4.3A to Figure 4.3F** for the Liverpool Range IBRA Subregion and **Figure 4.4A to Figure 4.4C** for the Kerrabee IBRA Subregion.

The details of each vegetation condition zone, including area, patch size class and the BAM survey plots required and completed, for the Liverpool Range IBRA Subregion are provided in **Table 4.10** and for the Kerrabee IBRA Subregion are provided in **Table 4.11**.

Table 4.10 Vegetation Condition Zones and patch sizes for the Liverpool Range IBRA Subregion

Vegetation Condition Zone ID	PCT ID number and name	Condition / other defining feature	Area (ha)	Patch size class (select multiple if areas of native vegetation are discontinuous)	No. vegetation integrity plots required	No. vegetation integrity plots completed	No. vegetation integrity plots used in assessment	Plot IDs of vegetation integrity plots used in assessment
1 – PCT 483 Remnant Trees	483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Roadside remnant forest	0.20	<input type="checkbox"/> <5 ha <input type="checkbox"/> 5–24 ha <input type="checkbox"/> 25–100 ha <input checked="" type="checkbox"/> >100 ha	1	3	3	Plot 2 Plot 11 Plot 12
2 – Exotic Dominated Derived Grassland (assessed against PCT 483)	483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley*	Exotic Dominated Grassland	3.12	<input type="checkbox"/> <5 ha <input type="checkbox"/> 5–24 ha <input type="checkbox"/> 25–100 ha <input checked="" type="checkbox"/> >100 ha	2	3	3	Plot 1 Plot 3 Plot 4
3 – PCT 1691 Roadside Remnant Forest	1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter	Roadside remnant forest	0.09	<input type="checkbox"/> <5 ha <input type="checkbox"/> 5–24 ha <input type="checkbox"/> 25–100 ha <input checked="" type="checkbox"/> >100 ha	1	1	1	Plot 10

Table 4.11 Vegetation Condition Zones and patch sizes for the Kerrabee IBRA Subregion

Vegetation Condition Zone ID	PCT ID number and name	Condition / other defining feature	Area (ha)	Patch size class (select multiple if areas of native vegetation are discontinuous)	No. vegetation integrity plots required	No. vegetation integrity plots completed	No. vegetation integrity plots used in assessment	Plot IDs of vegetation integrity plots used in assessment
4 – PCT 3334 Roadside Remnant Forest	3334 Western Hunter Flats Red Gum Sedge Forest	Roadside remnant forest	0.04	<input type="checkbox"/> <5 ha <input type="checkbox"/> 5–24 ha <input type="checkbox"/> 25–100 ha <input checked="" type="checkbox"/> >100 ha	1	1	1	Plot 9
5 – PCT 3388 Roadside Remnant Forest	3388 Central West Valleys White Box Forest	Roadside remnant forest	0.36	<input type="checkbox"/> <5 ha <input type="checkbox"/> 5–24 ha <input type="checkbox"/> 25–100 ha <input checked="" type="checkbox"/> >100 ha	1	1	1	Plot 6 Plot 7
6 – PCT 3781 Roadside Remnant Forest	3781 Ulan Sandstone Ironbark-Pine Woodland	Roadside remnant forest	1.05	<input type="checkbox"/> <5 ha <input type="checkbox"/> 5–24 ha <input type="checkbox"/> 25–100 ha <input checked="" type="checkbox"/> >100 ha	1	2	2	Plot 5 Plot 8

4.5 Vegetation Integrity (Vegetation Condition)

4.5.1 Vegetation Integrity Survey Plots

Details on the number of BAM plots (floristic and vegetation integrity survey plots) required and completed for each vegetation condition zone, in accordance with Table 3 of the BAM, are provided in **Table 4.11** and **Table 4.12**. The vegetation integrity plot survey locations are shown in **Figure 2.1**, **Figure 2.2** and **Figure 2.3A** to **Figure 2.3D** and the vegetation integrity plot survey data is provided in **Appendix D**.

4.5.2 Scores

The vegetation integrity condition scores for the BAM Plots completed are provided in **Table 4.12**. These values represent the combined scores from all plots completed for each vegetation condition zone, including the vegetation integrity score and the presence of hollow bearing trees.

Table 4.12 Vegetation Integrity Condition Scores

Vegetation Condition Zone No.	Vegetation Condition Zone Description	Composition Condition Score	Structure Condition Score	Function Condition Score	Vegetation Integrity Score	Hollow Bearing Trees Present?
1	PCT 483 Remnant Trees	74.2	89.1	96.7	96.7	Yes
2	Exotic Dominated Grassland (assessed against benchmarks of PCT 483)	12.9	5	15	9.9	No
3	PCT 1691 Roadside Remnant Forest	57.8	93.4	58	67.9	Yes
4	PCT 3334 Roadside Remnant Forest	40.9	78.3	74.7	62.1	No
5	PCT 3388 Roadside Remnant Forest	62.3	46	48.6	51.8	No
6	PCT 3781 Roadside Remnant Forest	82.4	74.6	86.8	81.1	Yes

4.5.3 Use of Benchmark Data

The current benchmarks values were utilised for this assessment.

5.0 Habitat Suitability for Threatened Species

5.1 Identification of Threatened Species for Assessment

5.1.1 Ecosystem Credit Species

The ecosystem credit species predicted to occur on or use the Development Footprint are identified in **Table 5.1** for the Liverpool Range IBRA Subregion and **Table 5.2** for the Kerrabee IBRA Subregion. Justification is provided for any species from the BAM-C automatically populated list excluded from assessment.

Table 5.1 Liverpool Range IBRA Subregion Predicted Ecosystem Credit Species

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species Retained for Further Assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone Species Retained Within			Sensitivity to Gain Class
		BC Act	EPBC Act						Zone 1 PCT 483	Zone 2 PCT 483	Zone 3 PCT 1691	
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	CE	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	High
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	-	No	BioNet Atlas	-	Yes	-	Y	Y	Y	Moderate
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	V	Yes / Foraging Habitat	BAM-C	Presence of <i>Allocasuarina</i> and <i>Casuarina</i> species	Yes	-	N	N	Y	High
Speckled Warbler	<i>Chthonicola sagittata</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species Retained for Further Assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone Species Retained Within			Sensitivity to Gain Class
		BC Act	EPBC Act						Zone 1 PCT 483	Zone 2 PCT 483	Zone 3 PCT 1691	
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	Moderate
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	No	BAM-C	-	Yes	-	N	N	Y	High
Black Falcon	<i>Falco subniger</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	Moderate
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-	No	BAM-C		Yes	-	Y	Y	Y	High
Painted Honeyeater	<i>Grantiella picta</i>	V	V	No	BAM-C	Mistletoes present at a density of greater than five mistletoes per hectare	Yes	-	Y	Y	Y	Moderate
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	-	Yes / Foraging Habitat	BAM-C	Within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Yes	-	N	N	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species Retained for Further Assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone Species Retained Within			Sensitivity to Gain Class
		BC Act	EPBC Act						Zone 1 PCT 483	Zone 2 PCT 483	Zone 3 PCT 1691	
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	N	Y	Moderate
White-throated Needle-tail	<i>Hirundapus caudacutus</i>	-	V	No	BAM-C	-	Yes	-	Y	Y	Y	High
Swift Parrot	<i>Lathamus discolor</i>	E	CE	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	Moderate
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	Moderate
Eastern Coastal Free-tailed bat	<i>Micronomus norfolkensis</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	N	Y	High
Turquoise Parrot	<i>Neophema pulchella</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	High
Barking Owl	<i>Ninox connivens</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species Retained for Further Assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone Species Retained Within			Sensitivity to Gain Class
		BC Act	EPBC Act						Zone 1 PCT 483	Zone 2 PCT 483	Zone 3 PCT 1691	
Powerful Owl	<i>Ninox strenua</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	N	Y	High
Scarlet Robin	<i>Petroica boodang</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	Moderate
Flame Robin	<i>Petroica phoenicea</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	Moderate
Common Planigale	<i>Planigale maculata</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-	No	BAM-C	-	Yes	-	-	-	Y	Moderate
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Yes / Foraging Habitat	BAM-C	-	Yes	-	-	-	Y	High
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	-	No	BAM-C	-	Yes	-	-	-	Y	High
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	-	No	BAM-C	-	Yes	-	-	-	Y	High
Masked Owl	<i>Tyto novaehollandiae</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	-	-	Y	High

Table 5.2 Kerrabee IBRA Subregion Predicted Ecosystem Credit Species

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	CE	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	N	High
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	E	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	V	Yes / Foraging Habitat	BAM-C	Presence of <i>Allocasuarina</i> and <i>Casuarina</i> species	Yes	-	Y	Y	Y	High
Speckled Warbler	<i>Chthonicola sagittata</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	High
Spotted Harrier	<i>Circus assimilis</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	High
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	Moderate

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	No	BAM-C	-	Yes	-	Y	Y	Y	High
Black Falcon	<i>Falco subniger</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	High
Painted Honeyeater	<i>Grantiella picta</i>	V	V	No	BioNet Atlas	Mistletoes present at a density of >5 per ha	Yes	-	Y	Y	Y	Moderate
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	-	Yes / Foraging Habitat	BAM-C	Within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Yes	-	Y	Y	Y	High
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	Y	Y	Moderate
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	-	Moderate
White-throated Needle-tail	<i>Hirundapus caudacutus</i>	-	V	No	BAM-C	-	Yes	-	Y	Y	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	E	E	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	N	Y	High
Swift Parrot	<i>Lathamus discolor</i>	E	CE	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Square-tailed Kite	<i>Lophoictinia isura</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	-	No	BioNet Atlas	-	Yes	-	Y	Y	Y	Moderate
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	-	No	BAM-C	-	Yes	-	Y	N	N	High
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	Y	N	High
Turquoise Parrot	<i>Neophema pulchella</i>	V	-	No	BioNet Atlas	-	Yes	-	Y	Y	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification for any Exclusions	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Barking Owl	<i>Ninox connivens</i>	V	-	Yes / Foraging Habitat	BAM-C	-	Yes	-	Y	Y	Y	High
Powerful Owl	<i>Ninox strenua</i>	V	-	Yes / Foraging Habitat	BA'-C	-	Yes	-	Y	Y	Y	High
Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>	V	V	No	BAM-C	-	Yes	-	Y	Y	Y	High
Scarlet Robin	<i>Petroica boodang</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	Moderate
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-	No	BAM-C	-	Yes	-	N	Y	Y	Moderate
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Yes / Foraging Habitat	BAM-C	-	Yes	-	N	Y	Y	High
Diamond Firetail	<i>Stagonopleura guttata</i>	V	-	No	BAM-C	-	Y's	-	N	Y	Y	Moderate
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	V	-	No	BAM-C	-	Yes	-	N	Y	N	High

5.1.2 Species Credit Species

5.1.2.1 Predicted Flora Species Credit Entities

The flora species credit species predicted to occur within the Development Footprint are identified in **Table 5.3** for the Liverpool Range IBRA Subregion and **Table 5.4** for the Kerrabee IBRA Subregion. Justification for any species excluded from further assessment is provided including the following detailed justification for the exclusion of *Prasophyllum* sp. Wybong.

Prasophyllum sp. Wybong ((C.Phelps ORG 5269)) is now considered to be *Prasophyllum petilum* (D.L.Jones & R.J. Bates) by Australian Plant Census and NSW PlantNet. Furthermore, the NSW Scientific Committee accepts *Prasophyllum* sp. 'Wybong' as synonymous with *Prasophyllum petilum*.

Prasophyllum petilum is listed as endangered under both BC Act and EPBC Act. *Prasophyllum petilum* was not identified by the BAM-C as candidate species for this BDAR. The BioNet Atlas currently only retains records of individuals from the Wybong / Muswellbrook area and Manilla NSW under the name *Prasophyllum* sp. Wybong with all other records held as *Prasophyllum petilum* (including records in both of those locations). This species has been described as occurring on fertile soils in grassy woodland or natural grassland (including derived natural grassland) (DAWE 2021a).

Prasophyllum petilum is associated with PCT 1691 which is mapped within the Development Footprint, however, is not associated with the IBRA subregion within which PCT 1691 has been mapped and therefore not predicted to occur within BAM-C. The species been recorded over approximately 25 km to the west near Wollar and 50 km to the east near Muswellbrook. These previous records are also located on or near fertile soils associated with Permian geology on the valley floor rather than elevated areas on fertile soils associated with sandstone / basalt geology which occurs within the Development Footprint. Given the significant topographical and geological differences between the Development Footprint and these previous record locations, it is considered that microhabitats for *Prasophyllum petilum* are not likely to be present. As such, *Prasophyllum* sp. Wybong and *Prasophyllum petilum* have been excluded from further assessment.

Table 5.3 Liverpool Range IBRA Subregion Predicted Flora Species Credit Species Determination.

Scientific Name	Common Name	Listing Status		Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	PCT and Vegetation Condition Zone species associated with (Retained = Y/ Excluded = N)			Sensitivity to Gain Class
		BC Act	EPBC Act					Zone 1 PCT 483	Zone 2 PCT 483	Zone 3 PCT 1691	
<i>Acacia pendula</i> Population	<i>Acacia pendula</i> Population in the Hunter Catchment	E. Pop.	-	BAM - C	-	Yes	-	-	Y	Very High	
<i>Cymbidium canaliculatum</i> Population	<i>Cymbidium canaliculatum</i> Population in the Hunter Catchment	E. Pop.	-	BAM - C	Epiphytic in a range of eucalypts, Acacia and Angophora, Fallen, standing dead timber including logs and cut stumps	Yes	-	-	Y	Moderate	
<i>Dichanthium setosum</i>	Bluegrass	V	V	BAM - C	-	Yes	-	Y	Y	Y	High
<i>Diuris tricolor</i>	Pine Donkey Orchid	V	-	BAM - C	-	Yes	-	-	-	Y	Moderate

Table 5.4 Kerrabee IBRA Subregion Candidate Flora Species Credit Species Determination

Scientific Name	Common Name	Listing Status		Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	PCT and Vegetation Condition Zone species associated with (Retained = Y/ Excluded = N)			Sensitivity to Gain Class
		BC Act	EPBC Act					Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
<i>Acacia ausfeldii</i>	Ausfeld's Wattle	V	-	BAM - C	Footslopes and low rises	Yes	-	-	Y	Y	High
<i>Commersonia procumbens</i> (syn. <i>Androcalva procumbens</i>)	<i>Commersonia procumbens</i>	V	V	BAM - C	Piliga Sandstone	No	Development Footprint is not on Piliga Sandstone	-	Y	Y	High
<i>Commersonia rosea</i> (syn. <i>Androcalva rosea</i>)	<i>Commersonia rosea</i>	E	E	BAM - C	-	Yes	-	-	Y		Moderate
<i>Cymbidium canaliculatum</i> endangered population	<i>Cymbidium canaliculatum</i> endangered population in the Hunter Catchment	E. Pop.	.	BAM - C	Epiphytic in a range of eucalypts, Acacia and Angophora, Fallen, standing dead timber including logs and cut stumps AND Hunter catchment as defined by Australia's River Basins (Geoscience Australia 1997)	Yes	-	-	Y	-	Moderate

Scientific Name	Common Name	Listing Status		Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	PCT and Vegetation Condition Zone species associated with (Retained = Y/ Excluded = N)			Sensitivity to Gain Class
		BC Act	EPBC Act					Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
<i>Diuris tricolor</i> Endangered Population	Pine Donkey Orchid population in the Muswellbrook LGA	V	-	BAM - C	Muswellbrook LGA	No	Development footprint not located within Muswellbrook LGA	-	Y	-	Moderate
<i>Eucalyptus cannonii</i>	Capertee Stringybark	V	-	BAM - C		Yes	-	-	Y	Y	Moderate
<i>Homoranthus darwinioides</i>	Fairy Bells	V	V	BAM-C	-	Yes	-	-	-	Y	High
<i>Ozothamnus tessellatus</i>	<i>Ozothamnus tessellatus</i>	V	V	BAM - C	-	Yes	-	-	Y	-	Moderate
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E	-	BAM - C	-	Yes	-	-		Y	High
<i>Prasophyllum</i> sp. Wybong	<i>Prasophyllum</i> sp. Wybong	-	CE	BAM - C	-	No	See detailed justification above this Table (Section 5.1.2.1).	-	Y	-	High
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi Mint-bush	V	V	BAM - C	-	Yes	-	-	Y	-	High
<i>Prostanthera discolor</i>	<i>Prostanthera discolor</i>	V	V	BAM - C	-	Yes	-	-	Y	-	High

Scientific Name	Common Name	Listing Status		Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	PCT and Vegetation Condition Zone species associated with (Retained = Y/ Excluded = N)			Sensitivity to Gain Class
		BC Act	EPBC Act					Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	

5.1.2.2 Predicted Fauna Species Credit Species

The fauna species credit species predicted to occur within the Development Footprint are identified in **Table 5.5** for the Liverpool Range IBRA Subregion and **Table 5.6** for the Kerrabee IBRA Subregion.

Justification is provided for any species from the BAM-C automatically populated list excluded from assessment, including listed geographic limitations, vagrant species, listed habitat constraints, degradation or lack of suitable microhabitats.

Table 5.5 Liverpool Range IBRA Subregion Candidate Threatened Fauna Species Credit Species Determination

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 1 PCT 483 ¹	Zone 2 PCT 483 ²	Zone 3 PCT 1691	
Pink-tailed Legless Lizard	<i>Aprasia parapulchella</i>	V	V	No	BAM-C	Rocky areas or within 50 m of rocky areas	Yes	-	Y	Y	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 1 PCT 483 ¹	Zone 2 PCT 483 ²	Zone 3 PCT 1691	
Bush Stone-curlew	<i>Burhinus grallarius</i>	E	-	No	BAM-C	Fallen/standing dead timber including logs	Yes	-	N	N	Y	High
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	V	Yes / Breeding Habitat	BAM-C	Hollow bearing trees Living or dead trees with hollows greater than 15 cm diameter and greater than 8 m above ground	Yes	-	N	N	Y	High
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	E	No	BAM-C	Cliffs Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2 km of old mines or tunnels	Yes	-	N	N	Y	Very High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 1 PCT 483 ¹	Zone 2 PCT 483 ²	Zone 3 PCT 1691	
Striped Legless Lizard	<i>Delma impar</i>	V	V	No	BAM-C	-	Species assessed as vagrant with precautionary rock rolling surveys completed	See Section 5.8	Y	Y	Y	Moderate
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	-	Yes / Breeding Habitat	BAM-C	Living or dead mature trees within suitable vegetation with 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Yes	-	N	N	Y	High
Little Eagle	<i>Hieraetus morphnoides</i>	V	-	Yes / Breeding Habitat	BAM-C	Nest trees – live (occasionally dead) large old trees within vegetation).	Yes	-	N	N	Y	Moderate
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	V	-	No	BAM-C	-	Yes	-	N	N	Y	High
Swift Parrot	<i>Lathamus discolor</i>	E	CE	Yes / Breeding Habitat	BAM-C	As per Important Habitat Map	No	No mapped important habitat present.	N	N	Y	Moderate

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 1 PCT 483 ¹	Zone 2 PCT 483 ²	Zone 3 PCT 1691	
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	-	Yes / Breeding Habitat	BAM-C	Caves Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC – in cave" "observation type code "E nest-root" "with numbers of individuals >500	No	Habitat constraints not present / no breeding roost structures such as caves, tunnels or mines present.	N	N	Y	Very High
Barking Owl	<i>Ninox connivens</i>	V	-	Yes / Breeding Habitat	BAM-C	Hollow bearing trees; Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	No	Habitat constraints not present within Liverpool Range IBRA Subregion or associated PCTs.	Y	Y	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 1 PCT 483 ¹	Zone 2 PCT 483 ²	Zone 3 PCT 1691	
Powerful Owl	<i>Ninox strenua</i>	V	-	Yes / Breeding Habitat	BAM-C	Hollow bearing trees Living or dead trees with hollows greater than 20 cm diameter	No	Habitat constraints not present within Liverpool Range IBRA Subregion or associated PCTs.	N	N	Y	High
Southern Greater Glider	<i>Petauroides volans</i>	E	E	No	BAM-C	-	Yes	-	N	N	Y	High
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	E	V	No	BAM-C	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliffines	Yes	-	N	N	Y	Very High
Koala	<i>Phascolarctos cinereus</i>	E	E	No	BAM-C	Presence of koala use trees – refer to Survey Comments in field TBDC	Yes	-	Y	Y	Y	High
Common Planigale	<i>Planigale maculata</i>	V	-		BAM-C	-	Yes	-	N	N	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 1 PCT 483 ¹	Zone 2 PCT 483 ²	Zone 3 PCT 1691	
Masked Owl	<i>Tyto novaehollandiae</i>	V	-	Yes / Breeding Habitat	BAM-C	Hollow bearing trees Living or dead trees with hollows greater than 20 cm diameter	No	Habitat constraints not present within Liverpool Range IBRA Subregion or associated PCTs.	N	N	Y	High

Table 5.6 Kerrabee IBRA Subregion Candidate Threatened Fauna Species Credit Species Determination

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Bush Stone-curlew	<i>Burhinus grallarius</i>	E	-	No	BAM-C	Fallen/standing dead timber including logs	Yes	-	Y	Y	N	High
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	E	Yes / Breeding Habitat	BAM-C	Hollow bearing trees Eucalypt tree species with hollows at least 3 m above ground and with hollow diameter of 7 cm or larger	Yes	-	Y	Y	Y	High
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	V	Yes / Breeding Habitat	BAM-C	Hollow bearing trees Living or dead trees with hollows greater than 15 cm diameter and greater than 8 m above ground	Yes	-	Y	Y	Y	High
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V	-	No	BAM-C	-	Yes	-	Y	Y	Y	High
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	E	No	BAM-C	Cliffs Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels	Yes	-	Y	Y	Y	Very High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Striped Legless Lizard	<i>Delma impar</i>	V	V	No	BAM-C	-	Species assessed as vagrant with precautionary rock rolling surveys completed	See Section 5.8	N	Y	N	Moderate
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	-	Yes / Breeding Habitat	BAM-C	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Yes	-	Y	Y	Y	High
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>	V	-	Yes / Breeding Habitat	BAM-C	Waterbodies or land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts	Yes	-	N	Y	Y	Moderate
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	V	V	No	BAM-C	-	Yes	-	N	Y	Y	Moderate

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-	Yes / Breeding Habitat	BAM-C	Nest trees - live (occasionally dead) large old trees within vegetation)	Yes	-	Y	Y	Y	Moderate
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	E	E	Yes / Breeding Habitat	BAM-C	Rocky areas including escarpments, outcrops and pagodas within the Sydney Sandstone geologies	Yes	-	N	N	Y	Very High
Swift Parrot	<i>Lathamus discolor</i>	E	CE	Yes / Breeding Habitat	BAM-C	Mapped important habitat	No	No mapped important habitat present	N/A	N/A	N/A	Moderate
Square-tailed Kite	<i>Lophoictinia isura</i>	V-	-	Yes / Breeding Habitat	BAM-C	Nest trees	Yes	-	Y	Y	Y	Moderate

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
		Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>						V-	-	Yes / Breeding Habitat	
Barking Owl	<i>Ninox connivens</i>	V	-	Yes / Breeding Habitat	BAM-C	Hollow bearing trees; Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	Yes	-	Y	Y	Y	High
Powerful Owl	<i>Ninox strenua</i>	V	-	Yes / Breeding Habitat	BAM-C	Hollow bearing trees Living or dead trees with hollows greater than 20 cm diameter	No	Habitat too disturbed. See Section 5.3.2 for further details	Y	Y	Y	High

Common Name	Scientific Name	Listing Status		Dual Credit Species	Sources	Habitat Constraints / Geographic Limitations	Species retained for further assessment?	Justification if excluded from further assessment	Associated PCT and Vegetation Condition Zone species retained within			Sensitivity to gain class
		BC Act	EPBC Act						Zone 4 PCT 3334	Zone 5 PCT 3388	Zone 6 PCT 3781	
Southern Greater Glider	<i>Petauroides volans</i>	E	E	No	BAM-C	-	Yes	-	N	Y	N	High
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	-	No	BAM-C	-	No	-	N	Y	Y	High
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	E	V	No	BAM-C	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliffines	Yes	-	Y	Y	Y	Very High
Koala	<i>Phascolarctos cinereus</i>	E	E	No	BAM—	Presence of koala use trees – refer to Survey Comments field in TBDC	Yes		N	Y	N	High
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Yes	BAM-C	Breeding Camps	No	No breeding camps present	N	Y	N	High
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	V	-	No	BAM-C	Caves or within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds	Yes	-	N	Y	N	Very High

5.2 Presence Determination for Candidate Species Credit Species

5.2.1 Threatened Flora Species

No threatened flora species were observed during surveys.

A summary of the methods used and determination of presence for candidate threatened flora species credit species is provided in **Table 5.7** for the Liverpool Range IBRA Subregion and **Table 5.8** for the Kerrabee IBRA Subregion. Further details on the surveys completed for the candidate threatened species are documented in detail in **Section 5.3**.

Some candidate species have been assumed to be present within the Development Footprint due to limitations in relation to survey timeframe, WHS considerations, and other ecological processes such as fire which can affect species germination and detectability. Refer to **Section 5.3** for details on specific species.

Table 5.7 Liverpool Range IBRA Subregion Determination of the Presence of Candidate Flora Species Credit species within the Development Footprint

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Acacia pendula</i> endangered population	<i>Acacia pendula</i> endangered population in the Hunter Catchment	E pop.	-	Targeted survey	No	No
<i>Cymbidium canaliculatum</i> - endangered population	<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	E pop.	-	Targeted survey	No	No
<i>Dichanthium setosum</i>	Bluegrass	V	V	Targeted survey	No	No
<i>Diuris tricolor</i>	Pine Donkey Orchid	V	-	Assumed presence	N/A	Yes
<i>Prostanthera cineolifera</i>	Singleton Mint Bush	V	V	Targeted survey	No	No
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E	-	Targeted survey	No	No

Table 5.8 Kerrabee IBRA Subregion Determination of the Presence of Candidate Flora Species Credit species within the Development Footprint Area

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Acacia ausfeldii</i>	Ausfeld's Wattle	V	Not Listed	Targeted Survey	No	No

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Commersonia procumbens</i> (syn. <i>Androcalva procumbens</i>)	-	V	V	Excluded based on habitat constraints	No	No
<i>Commersonia rosea</i>	-	E	E	Assumed presence	N/A	Yes
<i>Cymbidium canaliculatum</i> – Endangered Population	<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	E Pop	-	Targeted Survey	No	No
<i>Diuris tricolor</i> – endangered population	Pine Donkey Orchid population in the Muswellbrook local government area	E Pop	-	Excluded based on geographic constraints / Muswellbrook LGA	N/A	No
<i>Eucalyptus cannonii</i>	Capertee Stringybark	V	-	Targeted Survey	No	No
<i>Homoranthus darwinioides</i>	Fairy Bells	V	V	Targeted Survey	No	No
<i>Ozothamnus tessellatus</i>	-	V	V	Targeted Survey	No	No
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E	-	Targeted Survey	No	No
<i>Prasophyllum</i> sp. <i>Wybong</i>	<i>Prasophyllum</i> sp. <i>Wybong</i>	Not Listed	CE	Excluded based on absence of suitable microhabitats and lack of predicted habitat for <i>Prasophyllum petilum</i> (which is the same species).	N/A	No
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi Mint-bush	V	V	Targeted Survey	No	No
<i>Prostanthera discolor</i>	-	V	V	Targeted Survey	No	No
<i>Tylophora linearis</i>	-	V	E	Targeted Survey	No	No

5.2.2 Threatened Fauna Species

No candidate species credit threatened fauna species were observed during surveys.

A summary of the methods used and determination of presence for candidate threatened fauna species credit species is provided in **Table 5.9** for the Liverpool Range IBRA Subregion and **Table 5.10** for the Kerrabee IBRA Subregion. Further details on the surveys completed for the candidate threatened fauna species are documented in detail in **Section 5.3**.

Some candidate species have been assumed to be present within the Development Footprint due to limitations in relation to survey timeframe, WHS considerations, and other ecological processes such as fire which can affect species identification. Refer to **Section 5.3** for details on specific species.

Table 5.9 Liverpool Range IBRA Subregion Determination of the Presence of Candidate Fauna Species Credit species within the Development Footprint

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	Assessed by important habitat map	Mapped	Yes
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	Targeted survey	No	No
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	Targeted survey	No	No
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-	Targeted survey	No	No
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Targeted survey	No	No
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	E	Assumed presence	N/A	Yes
<i>Delma impar</i>	Striped Legless Lizard	V	V	Precautionary targeted rock rolling survey completed	No	No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	-	Targeted survey	No	No
<i>Hieraetus morphnoides</i>	Little Eagle	V	-	Targeted survey	No	No
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V	-	Assumed presence	N/A	Yes
<i>Lathamus discolor</i>	Swift Parrot	E	CE	Assessed by important habitat map	Not mapped	No
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	Excluded based on habitat constraints	No	No

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Ninox connivens</i>	Barking Owl	V	-	Excluded based on habitat constraints	N/A	No
<i>Ninox strenua</i>	Powerful Owl	V	-	Excluded based on habitat constraints	N/A	No
<i>Petauroides volans</i>	Southern Greater Glider	E	E	Targeted survey	No	No
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Targeted survey	No	No
<i>Phascolarctos cinereus</i>	Koala	E	E	Targeted survey	No	No
<i>Planigale maculata</i>	Common Planigale	V	-	Assumed presence	N/A	Yes
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Searches for camps as part of initial habitat assessment	No	No
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Excluded based on habitat constraints	N/A	No

Table 5.10 Kerrabee IBRA Subregion Determination of the Presence of Candidate Fauna Species Credit species within the Development Footprint

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	Assessed by important habitat map	Mapped	Yes
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	Targeted survey	No	No
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	E	Targeted survey	No	No
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	-	Targeted survey	No	No
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Targeted survey	No	No
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	E	Assumed present	N/A	Yes
<i>Delma impar</i>	Striped Legless Lizard	V	V	Precautionary targeted survey completed	No	No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	-	Targeted survey	No	No

Scientific Name	Common Name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	V	-	Targeted survey	No	No
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Assumed present	N/A	Yes
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Targeted survey	No	No
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	E	Assumed present	N/A	Yes
<i>Lathamus discolor</i>	Swift Parrot	E	CE	Assessed by important habitat map	Not mapped	No
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Targeted survey	No	No
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	Excluded based on habitat constraints	No	No
<i>Ninox connivens</i>	Barking Owl	V	-	Assumed present	N/A	Yes
<i>Ninox strenua</i>	Powerful Owl	V	-	Excluded, breeding habitat is degraded.	No	No
<i>Petauroides volans</i>	Southern Greater Glider	E	E	Targeted survey	No	No
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Targeted survey	No	No
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Targeted survey	No	No
<i>Phascolarctos cinereus</i>	Koala	E	E	Targeted survey	No	No
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Searches for camps as part of initial habitat assessments	No	No
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	Assumed present	N/A	Yes

5.3 Threatened Species Surveys

5.3.1 Candidate Threatened Flora Species Surveys

A summary of the targeted surveys completed for candidate threatened flora species is provided in **Table 5.11**. The proposed works will impact roadside vegetation with a width of generally less than 5 m on either side of the road for all assessment areas, the Development Footprint was searched with parallel transects on each side of the road to achieve a 5 m maximum traverse spacing.

Table 5.11 Summary of Species Credit Threatened Flora Surveys Completed

Flora Survey Details
<p>Ausfeld's Wattle <i>Acacia ausfeldii</i></p> <p>Habitat Description: Found to the east of Dubbo in the Mudgee-Ulan-Gulgong area of the NSW South Western Slopes bioregion, with some records in the adjoining Brigalow Belt South, South Eastern Highlands and the Sydney Basin bioregions. Populations are recorded from Yarrobil National Park, Goodiman State Conservation Area and there is a 1963 record from Munghorn Gap Nature Reserve. A large population is also known from Tuckland State Forest to the northwest of Gulgong (NSW DPE 2023c).</p> <p>Kerrabee IBRA Subregion Associated PCTs: 3388, 3781.</p> <p>Liverpool Range IBRA Subregion Associated PCTs: None.</p> <p>Habitat or Geographical Constraints: None listed.</p> <p>Survey Requirement: This species is a medium shrub which requires parallel field traverses at 10 m spacing in dense vegetation and 20 m in open vegetation. Use flowers and pods to identify as species can be confused with <i>A. verniciflua</i>.</p> <p>Survey period: Survey during August to October.</p> <p>Surveys Completed: Targeted 5 m parallel traverse survey completed during August 2023.</p> <p>Results: This species was not observed during surveys and has been assessed as not present.</p>
<p><i>Acacia pendula</i> Endangered Population in the Hunter Catchment</p> <p>Habitat Description: Within the Hunter catchment the species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations. Known to occur naturally as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. Only recorded to date at 6 locations: Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. These locations occur within the Muswellbrook and Singleton Local Government Areas, with the population potentially also occurring within the Mid-Western Regional and Upper Hunter LGA's (NSW DPE 2023c).</p> <p>Kerrabee IBRA Subregion Associated PCTs: None.</p> <p>Liverpool Range IBRA Subregion Associated PCTs: 1691.</p> <p>Habitat or Geographical Constraints: None listed.</p> <p>Survey Requirement: This species is a medium shrub which requires parallel field traverses at 10 m spacing in dense vegetation and -20 m spacing in open vegetation.</p> <p>Survey period: Surveys can be undertaken year-round.</p> <p>Surveys Completed: Targeted 5 m parallel traverse survey completed during August and November 2023.</p> <p>Results: This species was not observed during surveys and this species has been assessed as not present.</p>
<p><i>Commersonia procumbens</i> (syn. <i>Androcalva procumbens</i>)</p> <p>Habitat Description: Grows in sandy sites, often along roadsides. The species is often found as a pioneer species of disturbed habitats. It has been recorded colonising disturbed areas such as roadsides, the edges of quarries and gravel stockpiles and a recently cleared easement under power lines. Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also known in the Pilliga, Mount Kaputar National Park, north east of Gulgong and near Denman (NSW DPE 2023c).</p> <p>Kerrabee IBRA Subregion Associated PCTs: 3388, 3781.</p>

Flora Survey Details

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: Piliga Sandstone.

Survey Requirement: This species is a sub-shrub which requires parallel field traverses at 10 m spacing in dense vegetation and 15 m in open vegetation. Survey recent fire or mechanical disturbance areas which is required within the last 1–2 seasons for above ground identification.

Survey Period: Survey during August to May.

Surveys Completed: Surveys not required as the site does not contain the habitat constraint of ‘Piliga Sandstone’. The site is located on Banks Wall Sandstone and Liverpool East Basalt geology with minor areas of Alluvial Valley Deposits along watercourses. Despite no requirement for survey the species was included in the list of target species during parallel traverse survey completed during August 2023.

Results: This species was not observed during surveys and has been **excluded as a candidate species** due to the lack of habitat constraints (Piliga Sandstone), as per Section 5.2.1 of the BAM.

Commersonia rosea

Habitat Description: Occurs on skeletal sandy soils in scrub or heath vegetation with occasional emergent Narrow-leaved Ironbark (*Eucalyptus crebra*), Black Cypress Pine (*Callitris endlicheri*) or *E. caleyi* subsp. *caleyi*. Known from the central Hunter v’lley, extending from near Lee’s Pinch in Goulburn’River NP in the west to Payne’s Crossing near Wollombi in the east (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a sub-shrub which requires parallel field traverses at 10 m spacing in dense vegetation and 15 m in open vegetation. Fire ephemeral species, survey 18 months post fire, after 5 years the species will no longer persist above the ground. Expert report is strongly recommended to discount presence or absence if conditions do not meet requirements.

Survey Period: August to May.

Surveys Completed: Targeted 5 m parallel traverse survey completed during August 2023.

Results: This species was not observed during surveys. Given the vegetation within the Development Footprint has not been burnt within the past 18 months, this species has been **assessed as assumed present** in associated PCTs in accordance with the survey guidance.

Cymbidium canaliculatum Endangered Population in the Hunter Catchment

Habitat Description: Typically grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. It usually occurs singly or as a single clump, which can form large colonies on trees, between 2 and 6 m from the ground. Within the Hunter Catchment, *Cymbidium canaliculatum* is most commonly found in *Eucalyptus albens* (White Box) dominated woodlands (including those dominated by the intergrade *E. albens-moluccana*) (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Habitat or Geographical Constraints: Epiphytic in a range of eucalypts, *Acacia* and *Angophora*, cut stumps or logs on the ground.

Flora Survey Details

Survey Requirement: This species is an epiphytic orchid which can be surveyed year round. Parallel field traverses at 10 m spacing is recommended for open vegetation.

Survey Period: All year.

Surveys Completed: Targeted 5 m parallel traverse survey completed during August and November 2023.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Dichanthium setosum Bluegrass

Habitat Description: Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: None.

Liverpool Range IBRA Subregion Associated PCTs: 483, 1691.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a grass which requires parallel field traverses at 5 m spacing in dense vegetation and 10 m spacing in open vegetation. Use seed-head to identify.

Survey period: November–May, 3 to 4 weeks after effective rainfall.

Surveys Completed: Targeted during parallel traverse surveys for grasses, herbs and forbs at 5 m spacing during December 2022 and November 2023. Rainfall records for the Murrurundi weather station were referenced. There was >140 mm rainfall reported for the first two weeks of November 2022 and 40 mm of rainfall reported during October 2023.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Diuris tricolor Pine Donkey Orchid

Habitat Description: Usually recorded from disturbed habitats and associated *Callitris glaucophylla*, *Eucalyptus populnea*, *Eucalyptus intertexta*, Ironbark and *Acacia* shrubland, the understorey is often grassy with herbaceous plants such as Bulbine species (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: None.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is an orchid which requires parallel field traverses at 5 m spacing in dense vegetation and 10 m spacing in open vegetation. Use flowers to locate and identify. May require multiple surveys.

Survey Period: September. If not found survey again in October.

Surveys Completed: No targeted surveys completed.

Results: This species was not observed during surveys. No orchid species, including evidence of reproductive material of any *Diuris* species. The species flowered in September 2023 and as such peak flowering had finished when surveys were carried out. As such, this species has been **assessed as assumed present** in associated PCTs in accordance with the survey guidance.

Flora Survey Details

Eucalyptus cannonii Capertee Stringybark

Habitat Description: This species mostly occurs on rocky, usually poor, steep ridges in dry sclerophyll forest, although it can also be found in valleys and on gentle slopes. Associated with a range of species including *Eucalyptus viminalis*, *Eucalyptus mannifera*, *Eucalyptus polyanthemus*, *Eucalyptus rossii*, *Eucalyptus blakelyi*, *Eucalyptus oblonga*, *Eucalyptus sparsifolia*, *Eucalyptus bridgesiana*, *Eucalyptus dalrympleana*, *Eucalyptus melliodora*, *Eucalyptus dives* and *Angophora floribunda* (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a tree which requires parallel field traverses at 20 m spacing in dense vegetation and 40 m spacing in open vegetation. Use buds to identify. Flowering is sporadic and unreliable and taxonomic key identification requires buds. Hybridisation with *E. macrorhyncha* is also an issue. Survey multiple times throughout the year if buds are not present during a previous survey.

Survey period: All year.

Surveys Completed: Targeted 5 m parallel traverse survey completed during August 2023 and November 2023. No potential specimens observed and additional / multiple surveys to obtain buds are not needed.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Homoranthus darwinioides Fairy Bells

Habitat Description: Grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Associated species include *Callitris endlicheri*, *Eucalyptus crebra*, *E. fibrosa*, *Corymbia trachyphloia*, *E. beyeri* subsp. *illaquens*, *E. dwyeri*, *E. rossii*, *Leptospermum divaricatum*, *Melaleuca uncinata*, *Calytrix Tetragona*, *Allocasuarina* spp. and *Micromyrtus* spp (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a sub-shrub which requires parallel field traverses at 10 m spacing in dense vegetation and 15 m spacing in open vegetation. Survey a number of times throughout the year if not flowering when initially surveyed.

Survey period: Survey March to December.

Surveys Completed: Targeted 5 m parallel traverse survey completed during August and November 2023. Flowering observed during surveys at reference population checks at Lees Pinch.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Ozothamnus tessellatus

Habitat Description: Grows in Eucalypt woodland (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Flora Survey Details

Survey Requirement: This species is a sub-shrub which requires parallel field traverses at 10 m spacing in dense vegetation and 15 m spacing in open vegetation. Use flowers to locate, survey period is September to October based on flowering, however the TBDC identifies that it can be identified by foliage year-round.

Survey period: September to October.

Surveys Completed: Targeted 5 m parallel traverse surveys completed during August and November 2023 outside of the flowering period looking for the conspicuous foliage.

Results: This species was not observed during surveys and this species has been **assessed as not present**. Surveys were undertaken outside of the peak flowering period, however as noted in the TBDC, this species can be identified by its distinct foliage year-round. Furthermore, the associated PCT for this PCT does not have a dense shrub layer that would be likely to reduce detectability outside of the flowering season.

Pomaderris queenslandica Scant Pomaderris

Habitat Description: Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a medium shrub (1–6 m) which requires parallel field traverses at 10 m spacing in dense vegetation and 20 m spacing in open vegetation. Flowers are useful to identify, as easily confused with *P. intermedia*, however species can be distinguished by leaf morphology - *P. intermedia* generally has a much larger leaf compared to *P. queenslandica*.

Survey period: All year.

Surveys Completed: Targeted 5 m parallel traverse surveys completed during August and November 2023.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Prostanthera cryptandroides subsp. *cryptandroides* Wollemi Mint Bush

Habitat Description: Associated communities include Narrabeen Rocky Heath, Narrabeen Acacia Woodland, Narrabeen Exposed Woodland, open heath of *Calytrix tetragona*, *Leptospermum parviflorum* and *Isopogon dawsonii* and open scrubland of *Eucalyptus dwyeri*, *Baeckea densifolia*, *Dillwynia floribunda*, *Aotus ericoides* and *Hemigenia cunefolia* (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a medium-size shrub which requires parallel field traverses at 10 m space in dense vegetation and 20 m spacing in open vegetation. Use flowers to located and identify species.

Survey period: Survey September to November.

Surveys Completed: Targeted 5 m parallel traverse surveys completed during November 2023.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Flora Survey Details

Prostanthera discolor

Habitat Description: Grows in dry sclerophyll forest in the side gullies of main creeklines, often on rocky or well-drained alluvial substrates. Restricted to only two known localities in Bylong Valley, with a potential distribution in the Baerami Valley within the Mid-Western Regional local and Muswellbrook local government areas (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a medium shrub which requires parallel field traverses at 10 m space in dense vegetation and 20 m spacing in open vegetation. Use flowers to identify, flowering mainly occurring in September to October. Can be identified by the leaves as they have distinctive ciliate leaf margins.

Survey period: September to October.

Surveys Completed: Targeted 5 m survey completed just outside of peak flowering period during early November 2023 using parallel traverse method. Species can be identified outside of peak flowering period by foliage.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

Tylophora linearis

Habitat Description: Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *Eucalyptus sideroxylon*, *Eucalyptus albens*, *Callitris endlicheri*, *Callitris glaucophylla* and *Allocasuarina luehmannii* (NSW DPE 2023c).

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: None.

Habitat or Geographical Constraints: None listed.

Survey Requirement: This species is a twiner / sub-shrub which requires parallel field traverses at 10 m space in dense vegetation and 15 m spacing in open vegetation. Use flowers and fruit to locate and identify.

Survey period: Survey during October to May.

Surveys Completed: Targeted survey completed during November 2023 using 5 m parallel traverse method.

Results: This species was not observed during surveys and this species has been **assessed as not present**.

5.3.2 Candidate Threatened Fauna Species Surveys

Details of the targeted surveys completed for candidate threatened fauna species are provided in **Table 5.12**.

Table 5.12 Candidate Threatened Fauna Species Survey Details

Fauna Survey Details
<p>Regent Honeyeater <i>Anthochaera phrygia</i></p> <p>Credit Type: Dual credit species with mapped important habitat assessed for species credits and as potential SAI Entity and non-important habitat assessed for ecosystem credits.</p> <p>Habitat Description (mapped important habitat): The mapped areas include areas identified in The National Recovery Plan (DOE 2016a) as critical to the survival of the species formed the basis of the mapping for use in the BAM. These were refined to only include areas of suitable habitat based on expert opinion PCTs associated with the species (as per the TBDC). A dataset of occurrence records was generated from BioNet, BirdLife Australia, Australian National University Difficult Bird Research Group and expert opinion of historic, unrecorded breeding. Records were overlaid on the refined areas. All woodland vegetation within 200 m of a record was added. Records of known breeding events that occurred outside of the polygons created above were identified. Radial buffers of 1 km were applied to single breeding events (once off breeding at a location) and 5 km buffers applied to multiple breeding events (multiple events in the same year or over multiple years at one location). All woodland vegetation was selected within 1 km buffers. Within 5 km buffers, PCTs associated with the species were selected, along with all woodland vegetation within 200 m of a record.</p> <p>Associated PCTs: Not applicable, assessed via mapped important habitat.</p> <p>Survey Requirements: No surveys are required for species assessed via mapped important habitat.</p> <p>Survey Methods Employed: The BAM identifies that the species polygon for a species identified in BAM Subsection 5.2.4(2.d.), must include the entire area mapped on the important habitat map that occurs within the subject land. An assessment of the suitability of the habitat within the mapped important habitat area is not required or permitted to refine the mapping.</p> <p>Assessment Approach and Justification: This species has been assessed via the available important habitat mapping which overlaps with parts of the Development Footprint within the Kerrabee and Liverpool Range IBRA Subregions.</p>
<p>Pink-tailed Legless Lizard <i>Aprasia parapulchella</i></p> <p>Credit Type: Full species credit.</p> <p>Habitat Description: Areas of suitable habitat are typically well-drained, with rocky outcrops or scattered, partially-buried rocks (NSW DPE 2023c).</p> <p>Habitat or Geographical Constraints: Constrained to rocky areas within 50 m of rocky areas.</p> <p>Kerrabee IBRA Subregion Associated PCTs: None.</p> <p>Liverpool Range IBRA Subregion Associated PCTs: 483, 1691.</p> <p>Survey Requirements: Roll 200 rocks per 50 ha x 4 replicates within 2 hrs after sunrise or before sunset when temps are <25°C and cloud cover is <50% during September to November (Threatened Reptiles BAM Survey Guide DPE 2022c).</p> <p>Surveys Completed: Rock searches were undertaken by turning over suitably sized rocks in areas of suitable habitat for the associated PCTs and at one location within the Wollara Road Area which has no associated PCTs. When turning rocks observers carefully replaced the rocks to limit disturbance.</p> <p>A total of 200 rocks were turned along transects for each of the three separate parts of the Development Footprint, which was repeated on at least four different days (> 2,400 rock turns). The surveys were mostly undertaken within 2 hrs after sunrise or 2 hrs before sunset and only when cloud cover was <50% and temperatures were not greater than 25°C to ensure that a suitable thermal environment was present for the species to be sheltering under rocks.</p>

Fauna Survey Details

The rock-rolling surveys were completed on the following dates:

- 31 October 2023, 0/8 cloud, 25°C, still and fine survey completed between 1800 and 1845 x 1 site (Golden Highway Intersection Development Footprint Area).
- 1 November 2023, 25°C, 1/8 cloud, fine and still 1700–1630 (all parts of the Development Footprint).
- 2 November 2023, fine and still, 1/8 cloud 25°C 1700–1630 (all parts of the Development Footprint).
- 8 November 2023, overcast, 18°C light wind 0800–0830 (Bow River to Binks Road Development Footprint area).
- 9 November 2023, 17°C, light 1/8 cloud, still 0700–0800 (all parts of the Development Footprint).
- 10 November 2023, 14°C, Fog, overnight rain, still, 0725–0740 (Wollara Road Development Footprint).
- 17 November 2023, 15–17°C, 1–45% cloud cover, fine, 0714–0900 (all parts of the Development Footprint).

Surveys were undertaken outside of the Development Footprint, as there was a lack of rocks within much of the Development Footprint.

Assessment Approach and Justification: This species was not observed during surveys and has been **assessed as not present**.

Bush Stone-curlew *Burhinus grallarius*

Credit Type: Full species credit.

Habitat Description: Species is mainly found in western slopes and plains and the Riverina, smaller numbers occur in coastal areas such as on the Central and North Coast with increasing numbers in Tweed Valley. It may be easier to detect during breeding season, possibly calls all year, but it is unclear how well it responds to playback. The species was allocated to a species credit as experts determined that it cannot be predicted to occur at a site based on vegetation surrogates but can be detected reliably from survey (NSW DPE 2023c). There is only one record of this species on the BioNet Atlas from 1978 for the Kerrabee IBRA subregion and none for the Liverpool Range Brigalow Belt South IBRA Subregion.

Habitat or geographical constraints: Falling / standing dead timber including logs.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirements: Walking through habitat to flush birds/ day habitat search and spotlighting on foot or from vehicle at any time of year (P5-84 of DEC 2004).

Surveys Completed: Targeted surveys were completed which included walking through habitat to flush birds with a traverse through the Development Footprint completed on 1 November 2023 (3 hrs), 7 November 2023 (5 hrs), 8 November 2023 (1 hr), 9 November 2023 (7.5 hrs) and 16 November 2023 (2 hrs) and spotlighting from a vehicle and on foot through the Development Footprint undertaken on by two surveyors on 9 August 2023 (2 hrs), 10 August 2023 (2 hrs) and 7 November 2023 (1 hr 35 min).

Assessment Approach and Justification: This species was not observed during surveys and has been **assessed as not present**.

Fauna Survey Details

Gang-gang Cockatoo *Callocephalon fimbriatum*

Credit Type: Dual credit species with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas (NSW DPE 2023c).

Habitat or geographical constraints: Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Requirements: Survey requirements are specified in the TBDC. This is a dual credit species.

The identification of breeding habitat will require assumed presence, survey or an expert report. Survey period is October to January.

Step 1. Assessors should look for SIGNS OF BREEDING on site as follows; (a) lone adult males identified during the breeding season (October to January); or (b) an occupied nest. If breeding is presumed present, progress to Step 3.

Step 2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees are forest and woodland eucalypts containing hollows that are; (i) at least 3 m above the ground and (ii) with hollow diameter of 7 cm or larger.

Step 3. Where potential nest trees are identified on site, monitor for this species during the breeding season (October to January) to confirm the presence of any ACTUAL NEST TREES on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4. If actual nest trees are confirmed on site, then the species polygons are to be drawn around those actual nest trees (i.e. trees that birds of the species are known to have used for nesting). The species polygons should be circular in shape and must include a buffer radius of 200 m around each actual nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear, and the nest tree is already located near the edge of the wooded area.

Surveys Completed: Hollow bearing trees with hollows >7 cm in diameter and >3 m above ground were observed during habitat assessments undertaken. Diurnal bird surveys in accordance with Step 1 to 3 of the survey requirements were undertaken by two persons on 1 November 2023 (3 hrs), 7 November 2023 (5 hrs), 8 November 2023 (1 hr), 9 November 2023 (7.5 hrs) and 16 November 2023 (2 hrs). These surveys included diurnal census on foot with watching and listening for signs of activity such as begging chicks around potential nesting trees and presence of adult birds.

Assessment Approach and Justification: This species was not observed during surveys and has been **assessed as not present**.

Fauna Survey Details

South-eastern Glossy Black-Cockatoo *Calyptorhynchus lathami lathami*

Credit Type: Dual credit species with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur (NSW DPE 2023c).

Habitat or geographical constraints: Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground for species credit breeding habitat component and presence of *Allocasuarina* or *Casuarina* species for ecosystem credit foraging habitat component.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirements: Survey requirements are specified in the TBDC. This is a dual credit species. The identification of breeding habitat will require survey or an expert report. Survey period is January to September.

Step 1. Assessors should look for SIGNS OF BREEDING on site as follows; (a) begging birds of any age or sex; or (b) lone adult males identified during the breeding season (April to August); or (c) an occupied nest.

Step 2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees contain hollows that are; (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical.

Step 3. Where potential nest trees are identified on site, monitor for this species during the breeding season (Apr – Aug) to confirm the presence of any ACTUAL NEST TREES on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4. If actual nest trees are confirmed on site, then the species polygons are to be drawn around those actual nest trees (i.e. trees that birds of the species are known to have used for nesting). The species polygons should be circular in shape and must include a buffer radius of 200 m around each actual nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, subject land under assessment is linear, and the nest tree is already located near the edge of the wooded area.

Surveys Completed: Diurnal bird surveys in accordance with Step 1 of the survey requirements were undertaken on 7 August 2023 (4 hrs), 8 August 2023 (9 hrs) and 9 August 2023 (8 hrs). These surveys included diurnal census through the Development Footprint and listening for begging chicks around potential nesting trees.

Assessment Approach and Justification: This species was not observed during surveys and has been **assessed as not present**.

Fauna Survey Details

Eastern Pygmy-possum *Cercartetus nanus*

Credit Type: Full species credit.

Habitat Description: Found in a broad range of habitats from rainforest, sclerophyll forest and woodland and heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksia, eucalyptus and bottlebrush species (NSW DPE 2023c).

Habitat or geographical constraints: None listed.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirements: Survey period is October to March. TBDC provides no species-specific guideline requirements other than mentioning species is difficult to detect especially via spotlighting.

Surveys Completed: Camera trapping was completed with 243 trap nights achieved using 16 cameras (cameras mounted on trees with 14 mounted at approximately 1.5 m height and 2 mounted at <0.5 m height), during the first three weeks of November 2023. Camera trap lures consisted of a weatherproof bait cannister loosely packed with a sticky rolled oats, honey and peanut butter mixture, mounted on trees sprayed liberally with a honey-water mixture.

Spotlighting was completed for this species on 7 November 2023 by two people over 4.5 hrs.

Assessment Approach and Justification: This species was not observed during surveys and has been **assessed as not present**.

Large-eared Pied-bat *Chalinolobus dwyeri*

Credit Type: Full species credit.

Habitat Description: Found in well-timbered dry open forest and woodland areas at low to mid elevations (gullies) in areas containing or connected to extensive cliffs and caves (NSW DPE 2023c).

Under the BAM suitable habitats are defined by NSW OEH (2018) as PCTs associated with the species (as per the TBDC) within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings.

Habitat or geographical constraints: Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.

The presence of these habitat constraints is limited to the Wollara Road Development Footprint Area.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirements: Harp trapping or acoustic detection for 16 nights or roost searches / radio tracking during mid November to January. Traps should be set in woodlands, valley floors, riparian areas and relatively fertile parts of the subject land where possible.

Surveys Completed: No targeted surveys completed.

Assessment Approach and Justification: This species has been **assessed as assumed present** for associated PCTs, as targeted surveys were not completed.

Fauna Survey Details

Striped Legless Lizard *Delma impar*

Credit Type: Full species credit.

Habitat Description: Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component (NSW DPE 2023c). In New South Wales, this species occurs in the Southern Tablelands, the South Western Slopes and possibly in the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas, and from Tarcutta (DSEWPac 2011b). The species was once understood to occur within the Hunter Valley however the individuals within this locality have recently been described as a separate species, *Delma vescolineata* (Hunter Valley Delma) (Mahony et al., 2022).

Under the BAM suitable habitats are defined by DPE (2022c) as all PCTs on the subject land associated with the species in the TBDC.

Habitat or geographical constraints: None listed.

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: 483, 1691.

Survey Requirements:

Survey guidelines for Australia's threatened reptiles (DSEWPC 2011a) (primary reference available at time of Solar Farm site surveys):

- Surveys primarily undertaken during the active period of the species (between September and May). Some survey techniques (such as active searching) may be undertaken during the cooler months of the year, but often with less success.
- In areas with surface rock, artificial shelter site surveys or rock turning should be the primary technique (with supplementary techniques employed as appropriate).
- Artificial cover method detail:
 - Tiles installed at least three months prior to survey (i.e., before June).
 - September to December.
 - >30 ha, guideline suggests 10 tile grids. Each grid should be comprised of 10 x 5 tiles with 5 m spacing between tiles. For (i.e.,) a Development Footprint such as Goulburn River Solar Farm, this would equate to 500 tiles.
 - Tiles checked weekly for 8 weeks.
- Rock rolling method detail:
 - No minimum effort suggested, noted that success rate averages 1 positive observation per 150 rocks turned.

Threatened reptiles Biodiversity Assessment Method survey guide (DPE 2022c) (released following solar farm surveys):

- Habitat surveys (including turning over rocks) combined with either pitfall traps or artificial cover.
- Artificial cover:
 - Tiles installed at least three months prior to survey (i.e., before June).
 - September to December.

Fauna Survey Details

- >50 ha, guideline suggests 10 tile grids. Each grid should be comprised of 10 x 5 tiles with 5 m spacing between tiles. (i.e.,) a Development Footprint such as Goulburn River Solar Farm, this would equate to 500 tiles.
- Tiles checked weekly for 8 weeks.

Surveys Completed: Habitat searches / rock rolling was carried out in line with within Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011a) which identifies that in areas of surface rock, artificial shelter site surveys or rock turning should be the primary technique (with supplementary techniques employed as appropriate). Whilst the guidelines caution that rock rolling can be detrimental to *Delma impar*, given that monitoring was not long-term or intended to be undertaken regularly, and the amount of surface rock present, habitat searches (including rock rolling) was determined to be appropriate to the Project Area.

No minimum survey effort is specified for rock rolling, however DSEWPaC (2011a) notes that success rate averages 1 positive observation per 150 rocks turned. More than 2,400 rocks were turned in the Development Footprint.

Habitat surveys (searching around grass tussocks and rock rolling) are a key component of DSEWPC (2011a) and a mandatory requirement of the recently released DPE (2022c) for *Delma impar*. Surveys were carried out concurrently with surveys for the Pink-tailed Legless-lizard (31 October–17 November).

Surveys completed for *Delma impar* do not meet the requirements of the Threatened Reptiles BAM Survey Guide (DPE 2022c), however, this guideline was released in November 2022, following completion of threatened reptile surveys at the Goulburn River Solar Farm site. BOS Update 36 confirms that assessors are expected to apply new or amended survey guides to all assessments for which the survey component has yet to be completed.

Assessment Approach and Justification: No observations of any *Delma* species were made during the surveys undertaken.

Until recently, it was thought that a subpopulation of *Delma impar* occurred in the Hunter Valley, however it was determined to be a separate species, *Delma vescolineata*, which is not a subpopulation or part of a species complex with *Delma impar*. This is supported by DCCEEW (2023b) through reference to a scientific peer reviewed journal article (Mahony *et al.*, 2022), which includes the results of morphological, molecular and phylogenetic analyses. The study and advice from DCCEEW (2023b) demonstrate that individuals previously and incorrectly attributed to *Delma impar* in the Hunter Valley and Liverpool Ranges are a separate species now described as the Hunter Valley *Delma* (*Delma vescolineata*) (DCCEEW 2023b).

Delma impar (Fischer 1892) is listed as a threatened entity under Schedule 1, Part 3, Division 1 of the BC Act. It is known from Southern NSW, The Australian Capital Territory, Victoria and South Australia. *Delma vescolineata* (Mahony *et al.* 2022) has been described as a separate taxon following observations of *Delma* individuals in the Hunter Valley in 2012, north of any known *Delma impar* distribution. Only one other *Delma* species, *Delma plebeia*, is known from the Hunter Valley and Liverpool Plains, and individuals of *Delma vescolineata* may have previously been misidentified as *Delma plebeia* or *Delma impar*. The status of *Delma vescolineata* (Mahony *et al.* 2022) is as a new taxon, separate to *Delma impar*, requiring no change or review to the taxonomy of *Delma impar* (Fischer 1892). *Delma vescolineata* (Mahony *et al.* 2022) has not been split out of *Delma impar* and as such, *Delma impar* remains listed under the BC Act as per the 1892 published description. Accordingly, *Delma vescolineata* has never been part of any broader species concept of *Delma impar*, with individuals only misidentified or misapplied to *Delma impar*, and *Delma vescolineata* cannot be assessed as that species.

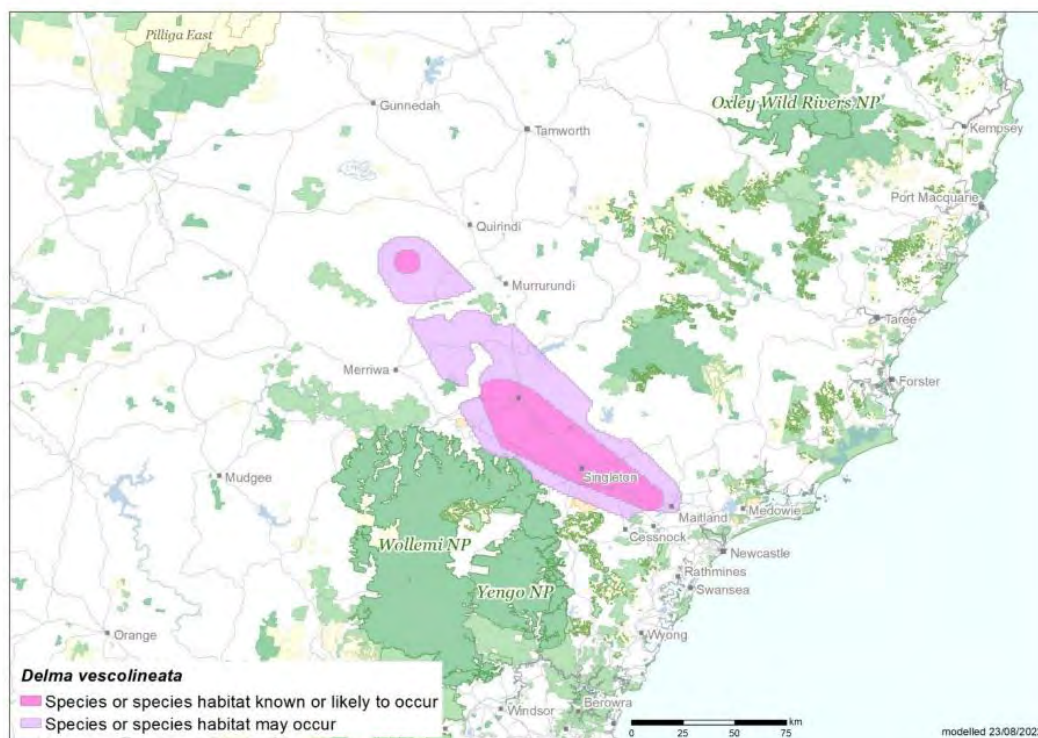
Delma vescolineata is not currently listed under the BC Act. Notwithstanding, BCD have advised that 'all occurrences within the *Delma impar* species complex are to be identified and assessed as *Delma impar* for NSW planning matters until a formal assessment of *Delma vescolineata* has been completed by the NSW Threatened Species Scientific Committee'. The species is not currently listed under the EPBC Act, although it is currently under consideration for listing. Entities listed under the EPBC Act after the referral decision is made, are not required to be further assessed.

Fauna Survey Details

As required by BCD advice, this assessment has considered *Delma impar* as a species complex, with due consideration given to both what is currently recognised as *Delma impar* (Fischer 1892) and what was previously understood to be the Hunter Valley population of the species, now known and herein referred to as *Delma vescolineata*.

The Development Footprint is significantly outside of the accepted range and associated climatic conditions (habitats and microhabitats), known to be inhabited by *Delma impar* (Fischer 1892). *Delma impar* (Fischer, 1892) is known from patchy distribution throughout south-eastern NSW as well as within the ACT, Victoria and South Australia. Mahony *et al.*, (2022) notes that the geographic ranges of *Delma impar* (Fischer 1892) and *Delma vescolineata* are allopatric with 250 km break between the two ranges, primarily corresponding to the extensively eroded valleys and tablelands of the Greater Blue Mountains that occur between the southern NSW grasslands and the grassland of the Hunter Valley and Liverpool Plains. Mahony *et al.* (2022) conclude that all records previously assigned to *Delma impar* (Fischer 1892) from the Hunter Valley region were in fact *Delma vescolineata*, with no evidence of *Delma impar* (Fischer 1892) present in the region.

Delma vescolineata is known from a 25 km wide corridor within a 60 km² area between Maitland and Muswellbrook that is assumed to be within one sub-population (DCCEEW 2023b; Mahony *et al.*, 2022). The outlying record (single observation) 80 km to the north near Parraweena on the Liverpool Plains is currently conservatively considered to be a separate subpopulation. The Development Footprint is also located outside of the areas of modelled known, likely and potential habitat for *Delma vescolineata* mapped by DCCEEW (2023b) and reproduced below.



Whilst it is possible that *Delma vescolineata* is more widely distributed across the Hunter Valley and Liverpool Plains than is currently known (Mahony *et al.* 2022) this uncertainty has been accounted for in the modelled distribution map prepared by DCCEEW (2023b) (Figure 2). The modelled distribution map for *Delma vescolineata* shows that the Development Footprint is approximately 30 km from where habitat for this species may occur, and 50 km from known or likely habitat.

Fauna Survey Details

Delma vescolineata is associated with secondary native grassland in association with sparse box-gum or ironbark woodland (Mahony *et al.* 2022, DCCEEW 2023b). The species is reliant on a diverse grass ground cover layer containing multiple species (*Austrostipa* spp., *Bothriochloa* spp. and *Chloris* spp.) (Mahony *et al.* 2022). Sites where this species has been confirmed include rehabilitated mine sites and pastoral land used for cattle grazing (Mahony *et al.* 2022). This indicates that *Delma vescolineata* is tolerant to disturbance. The species has been observed crossing roads, sheltering in roadside verges, and on featureless grazing paddocks, under cow pats, discarded rubbish, and rocks (DCCEEW 2023b).

The Development Footprint currently provides secondary grassland, aligning broadly with the habitat vegetative preference of *Delma vescolineata*.

It is considered that *Delma vescolineata* may be relatively restricted in range. The estimated area of occupancy for the species (48 km²) does not encompass the Development Footprint (DCCEEW 2023b). The information published by Mahony (2022) and DCCEEW (2023b) suggests that geographic limitations on the species' distribution means it is unlikely that *Delma vescolineata* historically occurred or currently occurs within the Development Footprint.

Additionally, a precautionary approach was adopted to assess the possible presence of a non-listed species with a low likelihood of occurrence. *Delma* sp. were surveyed for using a method (habitat searches) which is consistent with the available guidelines at the time of assessment, and is a method which has been proven to positively identify *Delma vescolineata* on other projects within the Hunter Valley region (i.e. Mount Pleasant Optimisation Project; SSD 104818). No *Delma* sp. were found to occur within the Development Footprint during targeted surveys.

Delma impar (Fisher 1892) and *Delma vescolineata* have therefore been **excluded from further assessment** under the BAM on the basis that the Development Footprint falls outside the known and modelled geographic ranges, such the species should be considered a vagrant.

White-bellied Sea-Eagle *Haliaeetus leucogaster*

Credit Type: Dual credit species with breeding habitat (nests) assessed for species credits and foraging habitat assessed for ecosystem credits or as prescribed impact if over water.

Habitat Description: Potential breeding habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes and the sea and within 1 km of these features (NSW DPE 2023c).

Habitat or geographical constraints: Living or dead mature trees within suitable vegetation within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirement: Survey July to December. Breeding habitat is live large old trees within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period. Due to the similarities in nest structure and use of the same nests by White-bellied Sea Eagles and Wedge-tailed Eagles, where a nest is observed without a bird present, searches for prey remains/feathers below the structure should be undertaken. The differing diets of both species and distinctive adult feathers, should provide evidence of nest use, however; where prey items/feathers are absent, repeat visits to the nest until a bird is observed should be undertaken.

DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Fauna Survey Details

Surveys Completed: Walking through habitat looking for birds and signs of large stick nests was completed on 7 August 2023 (4 hrs), 8 August 2023 (9 hrs) and 9 August 2023 (8 hrs), 1 November 2023 (3 hrs), 7 November 2023 (5 hrs), 8 November 2023 (1 hr), 9 November 2023 (7.5 hrs) and 16 November 2023 (2 hrs).

Assessment Approach and Justification: No White-bellied Sea-Eagles or potential nests were observed during surveys and this species has been **assessed as not present**.

Black-breasted Buzzard *Hamirostra melanosternon*

Credit Type: Dual credit species with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Hunts over grassland and well-timbered woodlands. Breeds from August to October near water in a tall tree. The stick nest is large and flat and lined with green leaves. Normally two eggs are laid (NSW DPE 2023c).

Habitat or geographical constraints: Land within 40 m of riparian woodland on inland watercourses / waterholes containing dead or dying eucalypts for species credit component of its habitat.

Kerrabee IBRA Subregion Associated PCTs: 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Guideline Requirement: Survey during September to November.

Surveys Completed: Walking through habitat looking for birds and signs of large stick nests was completed on 7 August 2023 (4 hrs), 8 August 2023 (9 hrs) and 9 August 2023 (8 hrs), 1 November 2023 (3 hrs), 7 November 2023 (5 hrs), 8 November 2023 (1 hr), 9 November 2023 (7.5 hrs) and 16 November 2023 (2 hrs).

Assessment Approach and Justification: This species was not observed during surveys and has been **assessed as not present**.

Giant Burrowing Frog *Heleioporus australiacus*

Credit Type: Full species credit.

Habitat Description: Suitable breeding habitat consists of ephemeral flowing streams that have permanent pools, or in upland swamps, and are located within native vegetation. Most typically breeding occurs in streams with a bed width of up to 5 m (e.g. 2nd order and 3rd order streams) and upland swamps located on suitable geologies. Non-breeding habitat is native vegetation adjacent to the breeding sites. Non-breeding habitat is any area of PCT on the subject land that is located within 300 m of suitable breeding habitat as individuals can be expected to migrate up to 300 m from breeding habitat to establish territories of essential non-breeding habitat (DPIE 2020d).

Habitat or geographical constraints: None listed although habitat is described as streams and within 300 m of waterways.

Kerrabee IBRA Subregion Associated PCTs: 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Guideline Requirement: The NSW Survey Guide for Threatened Frogs (DPIE 2020d) requires 8 repeat aural-visual surveys and 8 tadpole surveys for this species within a period of one week of receiving >50 mm of rainfall in 24 hours or > 100 mm of rainfall over 3 days.

Fauna Survey Details

Surveys Completed: No targeted survey able to be completed due to insufficient rainfall prior to survey period. Potential habitat is defined as 2nd and 3rd order streams and upland swamps on suitable geologies. The 2nd and 3rd order watercourses within the Kerrabee IBRA Subregion which intersect the Development Footprint were buffered by 300 m for associated PCTs, to create the species polygon.

Assessment approach and justification:

Despite the presence of suitable microhabitats, this species is considered unlikely to occur based on its known distribution which has a northern limit approximately 48 km to the south-east. This species has been **assessed as assumed present** in accordance with BCD advice.

Little Eagle *Hieraetus morphnoides*

Credit Type: Dual credit species with breeding habitat (nests) assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: Occupies open eucalypt forest, woodland or open woodland. Sheoak or *Acacia* woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (DPE 2023c).

Habitat or geographical constraints: Nest trees - live (occasionally dead) large old trees within vegetation.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirement: Survey August to October. Breeding habitat is live (occasionally dead) large old trees within suitable vegetation AND the presence of a male and female; or any adult with nesting material; or an individual on a large stick nest in the top half of the tree canopy; or pairs displaying (soaring, diving, engaging in chases, or a male observed calling in flight with a female begging from tree).

DPE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Surveys Completed: Habitat searches looking for birds and signs of large stick nests were undertaken on 7 August 2023 (4 hrs), 8 August 2023 (9 hrs) and 9 August 2023 (8 hrs).

Assessment Approach and Justification: No Little Eagles or potential nests were observed during surveys and this species has been **assessed as not present**.

Pale-headed Snake *Hoplocephalus bitorquatus*

Credit Type: Full species credit

Habitat Description: All PCTs associated with the species in the TBDC are considered to be suitable habitat according to DPE (2022c). This species is found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest and closer to riparian areas in dry environments. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees (DPE 2023).

Habitat or geographical constraints: None listed.

Kerrabee IBRA Subregion Associated PCTs: None.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Guideline Requirement: Spotlight survey November–March for 2 hrs x 4 replicates 30 minutes after sunset with ambient temperature >18°C AND Funnel Traps Nov-Mar. 72 Trap nights x 4 nights per 50 ha. Where possible survey 1–2 days after rain on humid nights (Threatened Reptiles BAM Survey Guide DPE 2022c).

Fauna Survey Details

Surveys Completed: Targeted surveys in accordance with Threatened Reptiles BAM Survey Guide (DPE 2022c) were not completed. However, no individuals were recorded during the spotlighting surveys completed for arboreal mammals. This involved spotlighting from a slow-moving vehicle (<5 km/hr) due to the roadside nature of the Development Areas, with some spotlight searches also completed on foot on the following nights: 9 August (2 hrs), 10 August (2 hrs) and 7 November (4.5 hrs). The proximity to the road to the Development Footprint meant that funnel traps were considered unsafe and at risk of theft/tampering/damage.

Assessment Approach and Justification: This species has been **assessed as assumed present** for the associated PCT, however it is considered not likely to occur based on historical records of which the closest is 72 km to the northwest, with no previous observations within the Goulburn River National Park or the connected Wollemi National Park.

Broad-headed Snake *Hoplocephalus bungaroides*

Credit Type: Dual credit species with occupied rocky habitats assessed for species credits and other habitats assessed for ecosystem credits.

Habitat Description: Rocky areas (with a 100 m buffer), including escarpments, outcrops and pagodas within the Sydney Sandstone geologies within PCTs associated with the species in the TBDC (DPE 2022c).

Kerrabee IBRA Subregion Associated PCTs: 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Guideline Requirement: Habitat surveys 2 hrs x 4 replicates (August – September) and spotlighting surveys 2 hrs x 4 consecutive nights (December to February) or artificial cover survey with 2 pavers per 40 m² placed 2 months before the survey x 4 replicates (August to September).

Surveys Completed: No targeted survey completed. Targeted surveys in accordance with Threatened Reptiles BAM Survey Guide (DPE 2022c) were not completed. However, no individuals were recorded during the spotlighting surveys completed for arboreal mammals. This involved spotlighting from a slow-moving vehicle (<5 km/hr) due to the roadside nature of the Development Footprint, with some spotlight searches also completed on foot on the following nights: 9 August (2 hrs), 10 August (2 hrs) and 7 November (4.5 hrs).

Assessment Approach and Justification: This species has been **assessed as assumed present** for parts of the associated PCT with suitable habitat, being rocky areas with a 100 m buffer.

Swift Parrot *Lathamus discolor*

Credit Type: Dual credit species with mapped important habitat assessed for species credits and as potential SAIL Entity. Non-important habitat is assessed for ecosystem credits.

Habitat Description (mapped important habitat): Swift parrot sighting records from 1990–2022 were extracted from BioNet and BirdLife Australia Atlas. Records were checked and cleaned. A 2 km radial buffer was applied to records. Areas with sightings of five or more birds recorded over any two or more years, or single sightings of 40 or more birds, were identified as important for the species. The NSW State Vegetation Type Map (SVTM) version C1.1.M1.1 was used to select Plant Community Types (PCTs) associated with the swift parrot (as per the Threatened Biodiversity Data Collection (TBDC)) within the 2 km buffers to create the important habitat map. Any isolated areas of vegetation less than one hectare were excluded.

Associated PCTs: Not applicable, assessed by mapped important habitat.

Survey Requirements: No surveys are required for species assessed via mapped important habitat.

Assessment Approach and Justification: The Development Footprint does not contain land mapped as important habitat for this species and this species has been **assessed as not present**.

Fauna Survey Details

Square-tailed Kite *Lophoictinia isura*

Credit Type: Dual credit species with breeding habitat (nests) assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: Occupies open eucalypt forest, woodland or open woodland. Sheoak or *Acacia* woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (DPE 2023c).

Habitat or geographical constraints: Nest trees.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Requirement: Survey September to January. Kites will need be in attendance to confirm breeding sites. Breeding habitat is live large old trees within suitable vegetation AND the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Surveys completed: Habitat searches looking for birds and signs of large stick nests were undertaken on 7 November 2023 (4 hrs).

Assessment Approach and Justification: No Square-tailed Kites or potential nests were observed during surveys and this species has been **assessed as not present**.

Large Bent-winged Bat *Miniopterus orianae oceanensis*

Credit Type: Dual credit species with breeding habitat assessed for species credits and non-breeding habitat (foraging and roosting) assessed for ecosystem credits.

Habitat Description: Foraging habitat typically consists of well-timbered areas in proximity to suitable day time roosts which are primarily caves but also tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. Cold caves are used for hibernation (DPE 2023c).

Maternity colonies have highly specific temperature and humidity requirements and form during spring and summer for the birthing and rearing of young (DPE 2023c).

Habitat or geographical constraints: Breeding habitat constraint is a cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirement: Desktop search for potential breeding habitat with site-based survey to confirm if this habitat constraint is present. If potential breeding habitat is identified harp traps should be placed close to exits of caves, mines or tunnels identified as survey habitat during December to February. Care should be taken to monitor traps to avoid overcrowding. Age, sex and reproductive status of captured bats must be assessed and recorded. At a minimum of two traps per night over two nights, repeated at least two weeks later is required.

Surveys completed: Desktop assessment and site-based traverses through the Development Footprint did not identify any areas of potential breeding habitat / habitat constraints.

Fauna Survey Details

Assessment Approach and Justification: Further surveys for this species are not required due to a lack of habitat constraints and breeding habitat for this species has been **assessed as not present**.

Barking Owl *Ninox connivens*

Credit Type: Dual credit species with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Species is likely to breed and forage within very small patches of vegetation (< 5 ha), especially when the patch is riparian vegetation or where the small patch is within 400 m of another larger patch of vegetation. They are unlikely to nest in the hollows of a paddock tree if the tree is separated from a larger patch of vegetation by more than 400 m of cleared habitat (DPE 2023c).

Habitat or geographical constraints: Breeding habitat constraint is living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: Not applicable, excluded based on habitat constraints.

Survey Requirement: Survey May to December. Where any known nest tree(s) occurs on site (e.g. known from existing data, studies or other documented evidence), a species polygon providing a circular buffer with a 100 m radius should be drawn around the known nest tree(s).

In addition, or where there are no known nest trees on site, assessors should apply the following process:

Step 1. Look for SIGNS OF BREEDING on site as follows; suitable habitat AND (a) presence of male and female OR (b) calling to each other (duetting) OR (c) find nest.

Step 2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.

Step 3. Where potential nest trees are identified on site then, night monitoring at the identified potential nest locations for a minimum of 2 nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m). DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake species surveys using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4. If monitoring of potential nest trees detects this owl species using, or demonstrating behaviour focussed on the trees (e.g. investigation of the hollow or roosting within 10 m) on site, the species polygons should be drawn around those trees (i.e. the identified potential nest trees where any owl of this species is observed using or focussing behaviour around the tree). The species polygons should be circular in shape and must include a buffer radius of 100 m around each tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The species uses paddock trees to extend foraging area from intact woodland. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear, and the nest tree is already located near the edge of the wooded area.

Fauna Survey Details

Surveys completed: Habitat search completed throughout the Development Footprint to determine the presence of suitable breeding hollows and signs of breeding / hollow use. Further nocturnal activity surveys were not completed due to seasonal constraints, This species is known to potentially nest in disturbed areas.

Assessment Approach and Justification: This species has been **assessed as assumed present** within associated PCTs with species polygon drawn around hollow-bearing trees observed to have suitable characteristics matching the listed habitat constraint with suitable buffer.

Powerful Owl *Ninox strenua*

Credit Type: Dual credit species with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: Inhabits a range of vegetation types from woodland to open sclerophyll forest, tall wet forest and rainforest. Requires large tracts of vegetation but can occur in fragmented landscapes with areas occupied being 400 ha to greater than 4000 ha depending on prey density. Nests in large tree hollows (at least 0.5 m deep) in large eucalypts (80–240 cm trunk diameter) that are at least 150 years old. The female and young nest in the hollow and the male roosts nearby during the day often in a dense grove that provides concealment (DPE 2023c).

Habitat or geographical constraints: Living or dead trees with hollow greater than 20 cm diameter.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: Not applicable, excluded based on habitat constraints.

Survey Requirement: Survey May to August. The species can breed and forage in very small patches of vegetation, although this is hugely variable across their range.

Where any nest tree(s) for which high fidelity is known to occur on site (e.g. known from existing data, studies or other documented evidence), a species polygon providing a circular buffer with a 100 m radius should be drawn around the known nest tree(s).

In addition, or where there are no known nest trees on site, assessors should apply the following process:

Step 1. Look for SIGNS OF BREEDING on site as follows; suitable habitat AND (a) presence of male and female OR (b) calling to each other (duetting) OR (c) find nest.

Note that this species does not respond as well to call-play-back and could require stag watching and other evidence of nesting.

Step 2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees are living or dead trees with hollows greater than 20 cm diameter.

Step 3. Where potential nest trees are identified on site, night monitoring at the identified potential nest locations for a minimum of 2 nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m). DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake species surveys using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4. If monitoring of potential nest trees detects this owl species using, or demonstrating behaviour focussed on the trees (e.g. investigation of the hollow or roosting within 10 m) on site, the species polygons should be drawn around those trees (i.e. the identified potential nest trees where any owl of this species is observed using, or focussing behaviour around the tree). The species polygons should be circular in shape and must include a buffer radius of 100 m around each tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding.

Fauna Survey Details

This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear, and the nest tree is already located near the edge of the wooded area.

Surveys completed: Habitat search completed throughout the Development Footprint to determine the presence of suitable breeding hollows and signs of breeding / hollow use. Three trees with hollows large enough to match the habitat constraint of >20 cm opening were observed however these trees were located on the edge of Wollara Road and are not located in a suitable microhabitat area to support a suitable nest tree for this species.

Assessment Approach and Justification: DECC (2006) identify that Powerful Owls nest sites are in old hollow eucalypts in unlogged, unburnt gullies and lower slopes, with hollows greater than 45 cm diameter and greater than 100 cm deep; surrounded by canopy trees and subcanopy or understorey trees or tall shrubs. LMCC (2014) also identifies that nest sites are within hollows of large, old growth, trees and roost sites associated with nest trees tend to be primarily beneath dense foliage within dense forest along creeklines or swamps or side gullies on steep slopes. It is acknowledged that parklands in urban areas sometimes support breeding pairs, however there is no evidence of disturbed roadside habitat use in areas which are otherwise undisturbed with abundant gully vegetation, such as the Tongo State Forest and the Goulburn River National Park. A 20 cm hollow entrance is also below the typical hollow sizes reported for this species in the literature of at least 30 to >45 cm wide (DEC 2006; LMCC 2014).

Breeding habitat for this species has been **assessed as not present based** on habitat disturbance levels and lack of suitable microhabitats within the Development Footprint, associated with the disturbed roadside environment and lack of a sheltered habitats with suitable areas for the male to roost during breeding.

Southern Greater Glider *Petaurus volans*

Credit Type: Full species credit.

Habitat Description: Inhabits eucalypt forests and woodlands. Hollow dependent species that will have large trees with hollows within its home range. Home range is < 5 ha and typically 1 to 3 ha. This species is sensitive to forest clearing and fragmentation as its movements are primarily restricted to gliding between trees over distances of typically 30 m (but up to 100 m) (NSW Scientific Committee 2015).

Habitat or geographical constraints: None listed.

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirement: No species-specific survey guideline has been published under the BAM. The Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities (DEC 2004) is the most directly relevant guide listed on the BAM Assessors webpage, which covers survey methods for non-flying mammals. Spotlighting was chosen as the most effective survey method available for this species due to its arboreal habit and leaf-based diet.

Spotlighting from a vehicle is specified at 2 x 1 km tracks with a maximum speed of 5 km per hour on 2 separate nights for up to 200 ha of stratification unit.

Spotlighting on foot is specified at 2 x 1 hour and 1 km up to 200 ha of stratification unit walking at 1 km per hour on 2 separate nights.

Under this guide spotlighting should focus on the least disturbed parts of the stratification unit and where the stratification unit is too small to achieve a 1 km traverse a proportionate amount of spotlighting must be done.

Fauna Survey Details

The Koala BAM Survey Guide is indirectly relevant to this species as the Southern Greater Glider is a tree dwelling mammal with a leaf-based diet. The survey effort for spotlighting under this guide is specified at two 200 m transects for every 5 ha of suitable habitat repeated once over two nights on foot at approximately 10 m per minute or where suitable habitat is characterised by low tree density from a vehicle moving at less than 5 km/hr.

Surveys completed: Spotlighting mostly from a slow-moving vehicle (<5 km/hr) due to the roadside nature of the Development Footprint, with some spotlight searches also completed on foot on the following nights: 9 August (2 hrs), 10 August (2 hrs) and 7 November (4.5 hrs).

Assessment Approach and Justification: This species was not observed during surveys and this species has been assessed as not present.

Squirrel Glider *Petaurus norfolcensis*

Credit Type: Full species credit.

Habitat Description: The Squirrel Glider inhabits floriferous eucalypt open forests and woodlands often with a *Banksia* or *Acacia* shrub layer. It requires den sites in tree cavities and a good winter supply of nectar (NSW Scientific Committee 2008).

Habitat or geographical constraints: None listed.

Kerrabee IBRA Subregion Associated PCTs: 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Requirement: No species-specific survey guideline has been published under the BAM.

The TBDC identifies that sites can be surveyed year-round and sites with bipinnate acacia, autumn to spring flowering trees and shrubs such as *Eucalyptus robusta* and *Banksia* sp. (for example, *Bankisa integrifolia* etc) should be subject to a more protracted survey period of between March-August. Relies on large old trees with hollows for breeding and nesting. These trees are also critical for movement and typically need to be closely-connected (i.e. no more than 50 m apart) to enable gliding.

The NSW Credit Supply Taskforce (CST) has provided draft guidance that identifies arboreal Elliot traps, remote camera traps and spotlighting as suitable methods with a requirement for spotlighting in combination with one of the other two methods.

Spotlighting

The Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities (DEC 2004) specifies that spotlighting from a vehicle is to consist of 2 x 1 km tracks with a maximum speed of 5 km per hour on 2 separate nights for up to 200 ha of stratification unit. Spotlighting on foot under this guide is specified at 2 x 1 hour and 1 km up to 200 ha of stratification unit walking at 1 km per hour on 2 separate nights. This guide identifies that spotlighting should focus on the least disturbed parts of the stratification unit and where the stratification unit is too small to achieve a 1 km traverse a proportionate amount of spotlighting must be done.

The Koala BAM Survey Guide is indirectly relevant in that it contains a BAM specific method for spotlighting. The survey effort for spotlighting under this guide is specified at two 200 m transects for every 5 ha of suitable habitat repeated once over two nights on foot at approximately 10 m per minute or where suitable habitat is characterised by low tree density from a vehicle moving at less than 5 km/hr.

The EPBC Act Survey Guidelines for Australia's Threatened Mammals (DSEWPac 2011c) provides a general guide for spotlighting effort of 2 x 200 m transects per 5 ha spaced at least 100 m and surveyed on two nights.

Fauna Survey Details

Baited Remote Cameras

The EPBC Act Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011c) provides a guide for camera trapping effort of 10 cameras x 14 nights per 5 ha, deployed over a 1 ha sampling area.

Surveys completed:

Spotlighting mostly from a slow-moving vehicle (<5 km/hr) due to the roadside nature of the Development Footprint, with some spotlight searches also completed on foot on the following nights: 9 August (2 hrs), 10 August (2 hrs) and 7 November (4.5 hrs).

Camera trapping was completed with 243 trap nights achieved using 16 cameras (cameras mounted on trees with 14 mounted at approximately 1.5 m height and 2 mounted at <0.5 m height), during the first three weeks of November 2023. Camera trap lures consisted of a weatherproof bait cannister loosely packed with a sticky rolled oats, honey and peanut butter mixture, mounted on trees sprayed liberally with a honey-water mixture.

Surveys were carried out by Dr. David Sharpe, BAM accredited expert in Squirrel Glider.

Habitat:

The Squirrel Glider does not appear to occupy habitats on low nutrient sandstone landscapes, such as that found in the south of the study area (PCT 3388). Sandstone landscapes are more typically occupied by the Sugar Glider, which was observed on several occasions during spotlighting. The Squirrel Glider is known to occupy single species stands of White Box in southern NSW. In coastal areas, Coastal Grey Box may be present in mixed species stands used by the Squirrel Glider but it may not be of particular importance. Whereas White Box flowers over several months in winter, Coastal Grey Box has a short flowering period in autumn (Eby and Law 2008). Areas with scattered trees and small patches dominated by White Box and/or Coastal Grey Box and/or a hybrid between them occur in the north of the study area. However, there may be insufficient tree cover in this part of the landscape to support a viable population of this species.

Assessment Approach and Justification: This species was not observed during surveys and suitable habitat does not appear to be present. This species has been **assessed as not present**.

Brush-tailed Rock-wallaby *Petrogale penicillata*

Credit Type: Full species credit.

Habitat Description: This species typically occupies steeply sloped rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. The home range consists of a refuge area and a foraging range linked by habitually used commuting routes (DPE 2023c).

Habitat or geographical constraints: Land within 1 km of rock escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirement: The EPBC Act Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011c) identifies the following as suitable survey methods for the species: daytime searches for habitat, daytime searches for signs of activity including tracks, scats and rock shelters worn smooth from resting, predator scat collection, baited camera traps and observations of wallabies basking from ground or helicopter. The TBDC identifies that systematic faecal pellet surveys and time lapse cameras should be considered as appropriate methods of survey.

Fauna Survey Details

Surveys completed: The surveys completed included daytime searches for scats, areas of potentially occupied habitat within the Development Footprint evidenced by the presence of shelters and worn marks on rocks and searches for wallabies. These daytime surveys were undertaken on two baited remote cameras which were positioned on tree trunks at approximately 0.5 m above ground within the disturbance area and a total effort of 30 trap nights was achieved between 1 to 16 November 2023.

Aerial imagery was analysed to determine areas of habitat constraints within 1 km, noting that this species prefers refugia with extensive rock outcropping on steep slopes such as extensive boulder piles, escarpments, gorges and clifflines and particularly those which are north facing. Potentially suitable habitat was identified from aerial imagery within 1 km of the Development Footprint such as within No. 1631 and No. 1673 Wollara Road Merriwa.

Assessment Approach and Justification: Only a small portion of the Development Footprint Area on Wollara Road is captured within the outer extents of 1 km buffers from areas of habitat constraint listed for this species. This species was not observed during surveys and this species has been **assessed as not present**.

Koala *Phascolarctos cinereus*

Credit Type: Full species credit.

Habitat Description: Inhabits eucalypt woodlands and forests where it feeds on the foliage. It feeds on at least 70 eucalypt species and 30- non-eucalypt species, but in any one area will select a limited number of preferred browse tree species. Spends most of its time in trees but descends to the ground to disperse or move throughout its home range which vary between 2 ha to > 100 ha (DPE 2023c).

Habitat or geographical constraints: None listed.

Kerrabee IBRA Subregion Associated PCTs: 3334, 3388, 3781.

Liverpool Range IBRA Subregion Associated PCTs: 483, 1691.

Survey Requirement: For areas of suitable habitat this species must be targeted with one direct and one indirect observation method including Spot Assessment Technique (SAT) (scat surveys) or detection dog searches and spotlighting, acoustic surveys or thermal drone surveys (DPE 2022d). For this survey spot assessment technique and spotlighting surveys were undertaken and the effort requirements for these are:

Spot assessment technique: for areas of < 50 ha undertake surveys using the SAT protocol at 150 m spacing sampling 30 trees per point at any time of the year (DPE 2022d).

Spotlighting surveys: A single 200 m transect for up to 5 ha of suitable habitat then two 200 m transects per 5 ha thereafter spaced at ≥100 m apart noting size and shape of the disturbance footprint will influence the arrangement of transects (DPE 2022d). Transects should be surveyed twice on separate nights on foot at a rate of 10 m/min (20 min / transect) or from a vehicle at a rate of 5 km/hr (DPE 2022d).

Surveys completed:

Spot Assessment Technique: Spot Assessment Surveys were completed at 150 m intervals where trees were present within the Development Footprint. A total of 38 SAT points were surveyed throughout the Development Footprint with up to 30 trees surveys at each point and a total of 580 trees searched. At some SAT points less than 30 trees were searched due to historical clearing and a lack of trees present. The locations of the SAT points surveyed are mapped in **Figure 2.7, Figure 2.8 and Figure 2.9A–D**.

Spotlighting mostly from a slow-moving vehicle (<5 km/hr) due to the roadside nature of the Development Footprint, with some spotlight searches also completed on foot on the following nights: 9 August (2 hrs), 10 August (2 hrs) and 7 November (4.5 hrs).

Spotlighting transects undertaken exceeded the survey effort requirement for the number of 200 m transects due to the narrow linear nature of the Development Footprint.

Fauna Survey Details
<p>Assessment Approach and Justification: This species was not observed during surveys and has been assessed as not present.</p>
<p>Common Planigale <i>Planigale maculata</i></p> <p>Credit Type: Full species credit.</p> <p>Habitat Description: Inhabits rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. (DPE 2023c).</p> <p>Habitat or geographical constraints: None listed.</p> <p>Kerrabee IBRA Subregion Associated PCTs: None.</p> <p>Liverpool Range IBRA Subregion Associated PCTs: 1691.</p> <p>Survey Requirement: The Common Planigale is a cryptic species that is difficult to detect. Survey any time of the year, noting that males are more active during winter, and juvenile dispersal usually occurs December–January. Survey must be undertaken using pitfall traps where the substrate allows. Occasionally, the substrate may be too rocky, hard or inundated to allow the use of pitfall traps. In these circumstances, it is strongly advised that an expert report is obtained. Survey should be delayed if heavy precipitation is forecast, to prevent the drowning of any fauna caught in the traps. Pitfall trap design: Ideally, each pitfall trap array should comprise 10 m of drift-fence with a 20 L or larger bucket with a lid at either end. The lid should be elevated 2 to 3 cm (using sticks) above the lip of the bucket and be black in colour to encourage animals to move under it. Leaf litter and small twigs should be placed in the bottom of each bucket to provide shelter for trapped animals.</p> <p>Target the placement of traps in suitable habitat within about 200 m of the ecotonal boundary of adjoining PCTs, in or adjacent to dense grass cover, deep leaf litter and/or abundant logs where Planigales would be expected to be present under the prevailing conditions (upslope of the ecotone in wet conditions and downslope in dry conditions). Traps must remain in place for a minimum of four consecutive nights.</p> <p>Pitfall traps need to be checked as soon as possible after first light (to reduce exposure and predation) and ideally, during the night as well, especially in the event of unforeseen rainfall events (to prevent drowning).</p> <p>A minimum of three pitfall trap arrays must be used for an area of suitable habitat up to 1 ha. For suitable habitat >1 ha–10 ha, one additional pitfall trap array must be used for every additional hectare, with a maximum of 10 pitfall trap arrays for any one patch of suitable habitat. Where suitable habitat patches are separated by 200 m or greater, the same survey effort must be applied in each patch. If the combined mapped areas of suitable habitat on the subject land is >10 ha, contact the Department for a modified survey approach.</p> <p>Surveys completed: No pitfall trapping completed. The proximity to the public road to the Development Footprint meant that pitfall traps were considered unsafe and at risk of theft/tampering/damage.</p> <p>Assessment Approach and Justification: This species was not observed during surveys and has been assessed as assumed present. The Development Footprint occurs outside the confirmed range of Common Planigale; thus it is considered unlikely to occur within the Development Footprint.</p>
<p>Grey-headed Flying-fox <i>Pteropus poliocephalus</i></p> <p>Credit Type: Dual credit species with species credits required for breeding habitat.</p> <p>Habitat Description: Breeding camps.</p> <p>Habitat or geographical constraints: Breeding camps.</p> <p>Kerrabee IBRA Subregion Associated PCTs: 3388.</p> <p>Liverpool Range IBRA Subregion Associated PCTs: 1691.</p>

Fauna Survey Details

Survey Requirement: The TBDC states that breeding camps will need to be identified by survey, as per OEH Guidelines. The initial search for camps should encompass any recorded camps and roosting habitat likely to occur on the subject land. If a camp is located the survey only needs to take place in the camp (that is the area occupied by the target species) to identify breeding females. Camps used for breeding must be mapped. Use GPS to map outer perimeter of the camp to create the species polygon.

The initial search for camps should encompass any recorded camps and roosting habitat likely to occur on the subject land. If a camp is located the survey only needs to take place in the camp (that is the area occupied by the target species) to identify breeding females.

Surveys completed: Initial searches were undertaken for camp sites and a check of the National Flying-fox Monitoring Viewer was undertaken.

Assessment Approach and Justification: The **habitat constraint of breeding camps is not present** and this species has been **excluded from further survey and assessment**. The closest known camp sites on the National Flying-fox Monitoring Viewer are at Muswellbrook and Mudgee.

Masked Owl *Tyto novaehollandiae*

Credit Type: Dual credit species with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits.

Habitat Description: A forest owl, but often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting (DPE 2023c).

DEC (2006) identify that this species nests in old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams and nest sites may be subject to a variety of disturbance regimes.

Habitat or geographical constraints: Living or dead trees with hollows greater than 20 cm diameter.

Kerrabee IBRA Subregion Associated PCTs: None.

Liverpool Range IBRA Subregion Associated PCTs: 1691.

Survey Requirement: Survey May to August. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements). The survey steps for Powerful Owl surveys provided in the TBDC have been adopted which specifies the following.

Step 1. Look for SIGNS OF BREEDING on site as follows; suitable habitat AND (a) presence of male and female OR (b) calling to each other (duetting) OR (c) find nest.

Step 2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees are living or dead trees with hollows greater than 20 cm diameter.

Step 3. Where potential nest trees are identified on site, night monitoring at the identified potential nest locations for a minimum of 2 nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m). DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake species surveys using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Fauna Survey Details

Step 4. If monitoring of potential nest trees detects this owl species using, or demonstrating behaviour focused on the trees (e.g. investigation of the hollow or roosting within 10 m) on site, the species polygons should be drawn around those trees (i.e. the identified potential nest trees where any owl of this species is observed using, or focussing behaviour around the tree). The species polygons should be circular in shape and must include a buffer radius of 100 m around each tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear, and the nest tree is already located near the edge of the wooded area.

Surveys completed: Habitat search completed throughout the Development Footprint to determine the presence of suitable breeding hollows and signs of breeding / hollow use.

Assessment Approach and Justification: This species was **excluded from further assessment** based on habitat constraints, including lack of suitably sized large hollow bearing trees within the Liverpool Range IBRA Subregion. This species is also not associated with any PCTS assessed within the Kerrabee IBRA Subregion.

Eastern Cave Bat *Vespadelus troughtoni*

Credit Type: Full species credit.

Habitat Description: A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest (DPE 2023c).

Under the BAM suitable habitats are defined by NSW OEH (2018) the PCTs on the subject land to which the species is associated (listed in the TBDC) that are within 2 km of identified potential roost habitat features. Potential breeding habitat is the PCTs associated with the species (as per the TBDC) within 100 m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.

Habitat or geographical constraints: Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds.

Kerrabee IBRA Subregion Associated PCTs: 3388.

Liverpool Range IBRA Subregion Associated PCTs: None.

Survey Requirements: Harp trapping or acoustic detection for 16 nights or roost searches / radio tracking during November to January. If acoustic detectors are used without harp trapping breeding will need to be assumed.

Surveys Completed: No targeted surveys completed.

Assessment Approach and Justification: This species has been **assessed as assumed present** as targeted surveys were not completed. The proximity to the public road to the Development Footprint meant that harp traps were considered unsafe and at risk of theft, tampering and/or damage.

5.4 Expert Reports and Use of More Appropriate Local Data

No expert reports were utilised in place of targeted surveys for the purposes of this assessment. This assessment has also not relied upon alternative data (more appropriate local data) to assess habitat suitability.

5.5 Area or Count, and Location of Suitable Habitat for a Species Credit Species (a Species Polygon)

5.5.1 Results for BC Act Listed Species Credit Entities

No threatened species listed within the BC Act were observed during surveys. The following ‘species credit type’ threatened species have been assessed as present based on important habitat mapping or assumed presence:

- *Commersonia rosea (Androcalva rosea)*
- Pine Donkey Orchid (*Diuris tricolor*)
- Regent honeyeater (*Anthochaera phrygia*)
- Large-eared Pied-bat (*Chalinolobus dwyeri*)
- Giant Burrowing Frog (*Heleioporus australiacus*)
- Pale-headed Snake (*Hoplocephalus bitorquatus*)
- Broad-headed Snake (*Hoplocephalus bungaroides*)
- Barking Owl (*Ninox connivens*)
- Common Planigale (*Planigale maculata*)
- Eastern Cave Bat (*Vespadelus troughtoni*).

Maps and details of the species polygons generated for each species above are provided as follows.

5.5.1.1 *Commersonia rosea (Androcalva rosea)* Species Polygon

This species was not observed during surveys and is assessed as assumed present as it is reported as only detectable within 5 years of fire. The species polygon details are provided in **Table 5.13** and the species polygon is mapped in **Figure 5.1A–C**.

Table 5.13 *Commersonia rosea (Androcalva rosea)* Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	3
SAll Entity	Yes
Habitat constraints	N/A
Associated PCTs	3388
Extent of suitable habitat present	0.36 ha
TBDC species specific assessment recommendations	Assess by area of habitat
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 5 – PCT 3388 VI Score = 51.8



1:5,000
Scale at A4

- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - *Commersonia rosea* Species Polygon

FIGURE 5.1A
Commersonia rosea Species Polygon



- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - *Commersonia rosea* Species Polygon

FIGURE 5.1B
Commersonia rosea Species Polygon



GDA 1994 MGA Zone 56

FIGURE 5.1C
Commersonia rosea Species Polygon

5.5.1.2 Pine Donkey Orchid (*Diuris tricolor*) Species Polygon

No targeted surveys were undertaken during the peak flowering period for this species and this species has been assessed as assumed present. The species polygon details are provided in **Table 5.14** and the species polygon is mapped in **Figure 5.2**.

Table 5.14 *Diuris tricolor* Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	2
SAll Entity	No
Habitat constraints	N/A
Associated PCTs	1691
Extent of suitable habitat present	0.09 ha
TBDC species specific assessment recommendations	Assess by area of habitat
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 3 – PCT 1691 VI Score = 67.9



1:5,000
Scale at A4

- Legend**
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - *Diuris Tricolor* Species Polygon

GDA 1994 MGA Zone 56

FIGURE 5.2
Diuris Tricolor Species Polygon

5.5.1.3 Regent honeyeater (*Anthochaera phrygia*) Species Polygon

This species is assessed on the basis of the presence of mapped important habitat. The species polygon details are provided in **Table 5.15** and the species polygon is mapped in **Figure 5.3A–C**.

Table 5.15 Regent Honeyeater Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	3
SAll Entity	Yes
Habitat constraints	Mapped important habitat
Associated PCTs	Not applicable
Extent of mapped habitat present	Vegetation Condition Zone 3 PCT 1691 = 0.02 ha Vegetation Condition Zone 4 PCT 3334 =< 0.01 ha Vegetation Condition Zone 5 PCT 3388 = 0.05 ha Vegetation Condition Zone 6 PCT 3781 = 0.08 ha Total PCT Area = 0.16 ha Cleared Land – Road Surface / Prescribed impact area = 0.14 ha Total Area = 0.3 ha
TBDC species specific assessment recommendations	Assess by area of mapped important habitat
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 3 PCT 1691 VI Score = 67.9 Vegetation Condition Zone 4 PCT 3334 VI Score = 62.1 Vegetation Condition Zone 5 3388 VI Score = 51.8 Vegetation Condition Zone 6 PCT 3781 VI Score = 81.1



1:5,000
Scale at A4

Legend






-  Road
-  Watercourse
-  Wollara Road Upgrade Development Footprint
-  Waterbodies
-  Regent Honeyeater Species Polygon

FIGURE 5.3A
Regent Honeyeater Species Polygon



1:5,000
Scale at A4

- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Regent Honeyeater Species Polygon

GDA 1994 MGA Zone 56

FIGURE 5.3B
Regent Honeyeater Species Polygon



1:5,000
Scale at A4

- Legend**
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Regent Honeyeater Species Polygon

FIGURE 5.3C
Regent Honeyeater Species Polygon

5.5.1.4 Large-eared Pied-bat (*Chalinolobus dwyeri*) Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken and associated PCTs are present. The species polygon details are provided in **Table 5.16**, the species polygon for foraging habitat is mapped in **Figure 5.4A–C** and a species polygon for potential breeding habitat is mapped in **Figure 5.4D**. The foraging habitat polygon was mapped using the associated PCTs and the breeding habitat polygon was mapped by analysis of high-resolution aerial imagery and topographic maps to identify potential breeding habitat features and the associated areas within 100 m.

Table 5.16 Large-eared Pied-bat Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	3
SAIL Entity	Yes / breeding habitat only
Habitat constraints	Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices or within 2 km of old mines and tunnels.
Associated PCTs	PCT 1691, 3334, 3388 and 3781
Extent of mapped habitat present (foraging)	Vegetation Condition Zone 3 PCT 1691 = 0.09 ha Vegetation Condition Zone 4 PCT 3334 = 0.04 ha Vegetation Condition Zone 5 PCT 3388 = 0.36 ha Vegetation Condition Zone 6 PCT 3781 = 1.05 ha Total Area = 1.54 ha
Extent of mapped habitat present (breeding)	Vegetation Condition Zone 6 PCT 3781 = 0.01 ha Total Area = 0.01
TBDC species specific assessment recommendations	Use topographic maps and high-resolution imagery to identify habitat features within 2 km of the subject land. Create two buffers: one for breeding habitat (as described in Figure 1), and one for species habitat. For this species the feature is caves, scarps, cliffs, rock overhangs and disused mines and the buffer distances are 100 m for breeding habitat and 2 km for species habitat.
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 3 PCT 1691 VI Score = 67.9 Vegetation Condition Zone 4 PCT 3334 VI Score = 62.1 Vegetation Condition Zone 5 PCT 3388 VI Score = 51.8 Vegetation Condition Zone 6 PCT 3781 VI Score = 81.1



1:5,000
Scale at A4

0 0.1 0.2 Kilometres

- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Large-eared Pied Bat Foraging Habitat Species Polygon

GDA 1994 MGA Zone 56

FIGURE 5.4A
Large-eared Pied Bat Foraging Habitat Species Polygon

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



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1:5,000
Scale at A4

0 0.1 0.2 Kilometres

- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Large-eared Pied Bat Foraging Habitat Species Polygon

GDA 1994 MGA Zone 56

FIGURE 5.4B
Large-eared Pied Bat Foraging Habitat Species Polygon

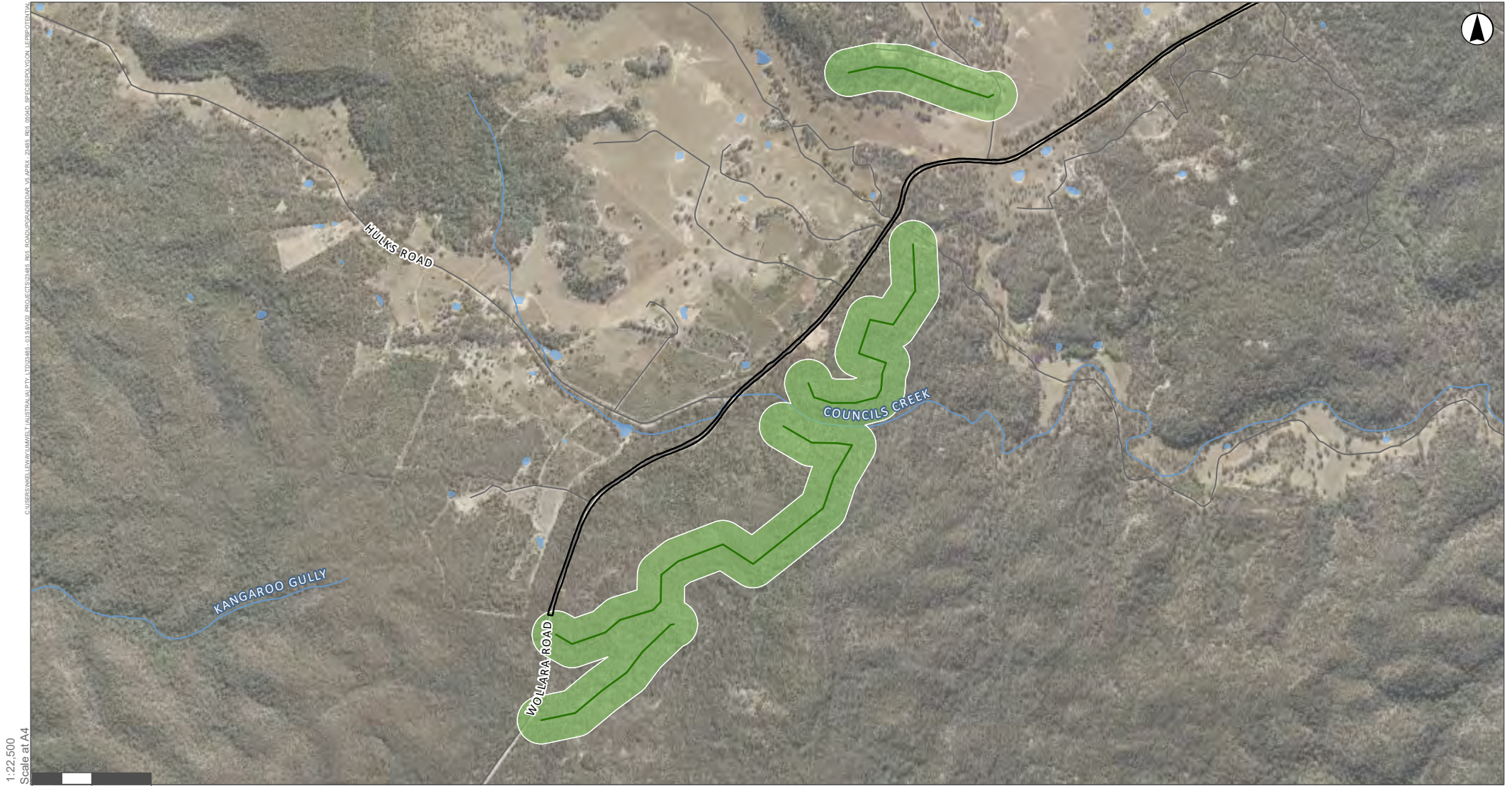


1:5,000
Scale at A4

- Legend
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Large-eared Pied Bat Foraging Habitat Species Polygon

GDA 1994 MGA Zone 56

FIGURE 5.4C
Large-eared Pied Bat Foraging Habitat Species Polygon



1:22,500
Scale at A4

0 0.25 0.5 Kilometres

Legend

- Road
- Watercourse
- Wollara Road Upgrade Development Footprint
- Waterbodies

- 'Large-eared Pied Bat Potential Breeding Habitat (cliff line/rock outcrop)
- Large-eared Pied Bat Species Polygon Breeding Habitat (100m buffer area)

GDA 1994 MGA Zone 56

FIGURE 5.4D
Large-eared Pied Bat Species
Polygon Breeding Habitat

Giant Burrowing Frog (*Heleioporus australiacus*) Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken. The species polygon details are provided in **Table 5.17** and the species polygon is mapped in **Figure 5.5**.

Table 5.17 Giant Burrowing Frog Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	1.5
SAll Entity	No
Habitat constraints	None listed
Associated PCTs	PCT 3388 and PCT 3781
Extent of mapped habitat present	Vegetation Condition Zone 5 PCT 3388 = 0.29 ha Vegetation Condition Zone 6 PCT 3781 = 0.61 Total Area = 0.9 ha
TBDC species specific assessment recommendations	The species polygon boundary should align with suitable aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 300 m radius from the top of bank. As no records were made the species polygon has been buffered from all 2 nd and 3 rd order streams as per the NSW Survey Guide for Threatened Frogs definition of suitable habitat and areas of associated PCTs have been included within the species polygon. Areas of non-associated PCTs were not included within the species polygon.
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 5 3388 VI Score = 51.8 Vegetation Condition Zone 6 PCT 3781 VI Score = 81.1



1:10,000
Scale at A4

0 0.1 0.2 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Potential Giant Burrowing Frog Breeding Habitat (Second and Third Order Streams)
 - Second and Third Order Stream Buffer (300 m)
 - Giant Burrowing Frog Species Polygon

FIGURE 5.5A
Giant Burrowing Frog Species Polygon



GDA 1994 MGA Zone 56

Legend

- Road
- Wollara Road Upgrade Development Footprint
- Waterbodies
- Potential Giant Burrowing Frog Breeding Habitat (Second and Third Order Streams)
- Second and Third Order Stream Buffer (300 m)
- Giant Burrowing Frog Species Polygon

FIGURE 5.5B
Giant Burrowing Frog Species Polygon

5.5.1.5 Pale-headed Snake (*Hoplocephalus bitorquatus*) Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken. The species polygon details are provided in **Table 5.18** and the species polygon is mapped in **Figure 5.6**.

Table 5.18 Pale-headed Snake Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	2
SAIL Entity	No
Habitat constraints	None listed
Associated PCTs	PCT 1691
Extent of mapped habitat present	Vegetation Condition Zone 3 PCT 1691 = 0.09 ha Total Area = 0.09 ha
TBDC species specific assessment recommendations	Suitable habitat is all PCTs associated with the species in the TBDC, map the species polygon to the full extent of all suitable habitat on the subject land.
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 3 PCT 1691 VI Score = 67.9



1:5,000
Scale at A4

- Legend**
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Pale-headed Snake Species Polygon

GDA 1994 MGA Zone 56

FIGURE 5.6
Pale-headed Snake Species Polygon

5.5.1.6 Broad-headed Snake (*Hoplocephalus bungaroides*) Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken. The species polygon details are provided in **Table 5.19** and the species polygon is mapped in **Figure 5.7A–C**. A precautionary approach was adopted when mapping habitat for this species, there are no escarpments, substantial outcrops or pagodas within the Development Footprint, however due to the presence of minor areas of surface rock and outcropping adjacent to areas of the associate PCT 3781, the entire extent of this PCT was mapped as the species polygon.

Table 5.19 Broad-headed Snake Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	1.5
SAll Entity	No
Habitat constraints	None listed
Associated PCTs	PCT 3781
Extent of mapped habitat present	Vegetation Condition Zone 6 PCT 3781 = 1.05 ha Total Area = 1.05 ha
TBDC species specific assessment recommendations	Rocky areas, including escarpments, outcrops and pagodas within the Sydney Sandstone geologies (including a 100 m buffer) within PCTs associated with the species in the TBDC. Map the species polygon to the full extent of all suitable habitat on the subject land. Include a 100 m buffer from the edge of suitable habitat.
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 6 PCT 3781 VI Score = 81.1



1:5,000
Scale at A4

Legend

- Road
- Watercourse
- Wollara Road Upgrade Development Footprint
- Waterbodies
- Broad-headed Snake Species Polygon

FIGURE 5.7A
Broad-headed Snake Species Polygon



- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Broad-headed Snake Species Polygon

FIGURE 5.7B
Broad-headed Snake Species Polygon



1:5,000
Scale at A4

- Legend**
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Broad-headed Snake Species Polygon

FIGURE 5.7C
Broad-headed Snake Species Polygon

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

5.5.1.7 Barking Owl *Ninox connivens* Breeding Habitat– Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken and associated PCTs are present. The species polygon details are provided in **Table 5.20** and the species polygon is mapped in **Figure 5.8A–B**. There are three large hollow bearing trees present within the Development Footprint, these are limited to the Wollara Road Upgrade Development Footprint. A 100 m buffer around each of these trees was intersected with the Development Footprint to create the species polygon.

Table 5.20 Barking Owl Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	2
SAIL Entity	No
Habitat constraints	Trees with hollows greater than 20 cm in diameter and greater than 4 m above the ground.
Associated PCTs	PCTs 3334, 3388, 3781, 483 and 1691
Extent of mapped habitat present	Vegetation Condition Zone 5 PCT 3388 = 0.02 ha Vegetation Condition Zone 6 PCT 3781 = 0.29 ha Total Area = 0.30 ha
TBDC species specific assessment recommendations	Map species polygon by providing a circular buffer with a 100 m radius around nest trees.
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 5 3388 VI Score = 51.8 Vegetation Condition Zone 6 PCT 3781 VI Score = 81.1



1:5,000
Scale at A4

- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Large Hollow-bearing Trees (>20cm Opening)
 - Large hollow-bearing Tree (100m buffer)
 - Barking Owl Species Polygon

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

FIGURE 5.8A
Barking Owl Species Polygon



Legend

- Road
- Watercourse
- ▭ Wollara Road Upgrade Development Footprint
- Waterbodies
- Large Hollow-bearing Trees (>20cm Opening)
- Large hollow-bearing Tree (100m buffer)
- Barking Owl Species Polygon

FIGURE 5.8B
Barking Owl Species Polygon

5.5.1.8 Common Planigale (*Planigale maculata*) Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken and associated PCTs are present. The species polygon details are provided in **Table 5.21** and the species polygon is mapped in **Figure 5.9**.

Table 5.21 Common Planigale Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	2
SAIL Entity	No
Habitat constraints	-
Associated PCTs	PCT 1691
Extent of mapped habitat present	Vegetation Condition Zone 3 PCT 1691 = 0.09 ha Total Area = 0.09 ha
TBDC species specific assessment recommendations	The following advice for mapping the species polygon is provided by BCD in the TBDC and does not provide any relevant logical guidance and the species polygon mapping, so the species polygon mapped for this assessment included the full extent of the associated PCT present. <i>The species polygon is drawn to 500 m either side of the PCT ecotonal boundary, or to the other PCT boundary, whichever is smaller. Note the ecotonal zone is the boundary between a 'wet' PCT and a 'dry' PCT. Under drier conditions, the species moves into the lower elevation 'wet' PCT, and under wetter conditions it moves upslope to the higher elevation 'dry' PCT.</i>
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 3 PCT 1691 VI Score = 67.9



- Legend**
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Common Planigale Species Polygon

FIGURE 5.9
Common Planigale Species Polygon

5.5.1.9 Eastern Cave Bat (*Vespadelus troughtoni*) Species Polygon

This species is assessed as assumed present as no targeted surveys were undertaken and associated PCTs are present. The species polygon details are provided in **Table 5.22**, the species polygon for foraging habitat is mapped in **Figure 5.10A–C** and a species polygon for potential breeding habitat is mapped in **Figure 5.10D**. The foraging habitat polygon was mapped using the associated PCTs and the breeding habitat polygon was mapped by analysis of high-resolution aerial imagery and topographic maps to identify potential breeding habitat and the associated areas within 100 m.

Table 5.22 Eastern Cave-Bat Species Polygon Details

Information Required	Species Polygon Details
Biodiversity Risk Weighting	3
SAIL Entity	Yes / breeding habitat only
Habitat constraints	Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds.
Associated PCTs	PCT 3388
Extent of mapped habitat present	Vegetation Condition Zone 5 PCT 3388 = 0.36 ha Total Area = 0.36 ha
TBDC species specific assessment recommendations	<p>Approach to create species polygon: Two polygons may be required, one for species habitat for credit generation and one for breeding habitat (for the SAIL consideration) if both the species and breeding individuals are present or assumed present. Use high resolution aerial imagery and topographic maps to identify and map potential roost habitat features such as caves, scarps, cliffs, rock overhangs or disused mines within 2 km of the subject land.</p> <p>Potential habitat: All areas with the PCTs associated with the species (as per the TBDC) on the subject land where the subject land is within 2 km of caves, scarps, cliffs, rock overhangs and disused mines.</p> <p>Potential breeding habitat: All potential habitat on the subject land where the subject land is within 100 m of caves, scarps, cliffs, rock overhangs and disused mines.</p> <p>Features to include within the species polygon: The species polygon boundary should align with all PCTs on the subject land that are within 2 km of identified potential roost habitat features, and with which the species is associated (as listed in the TBDC).</p> <p>Where breeding habitat is also present, an additional species polygon for the breeding habitat must include all breeding habitat on or within 100 m of the subject land. The polygon must incorporate the habitat feature and a buffer of at least 100 m wide (or 100 m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid. Artificial structures should be inspected and included if the species is using these features for breeding.</p>
Habitat condition (Vegetation integrity score for each vegetation condition zone in the species polygon)	Vegetation Condition Zone 5 3388 VI Score = 51.8



1:5,000
Scale at A4

Legend

- Road
- Watercourse
- ▭ Wollara Road Upgrade Development Footprint
- Waterbodies
- Eastern Cave Bat Foraging Habitat Species Polygon

FIGURE 5.10A
Eastern Cave Bat Foraging Habitat Species Polygon

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



- Legend**
- Road
 - Watercourse
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Eastern Cave Bat Foraging Habitat Species Polygon

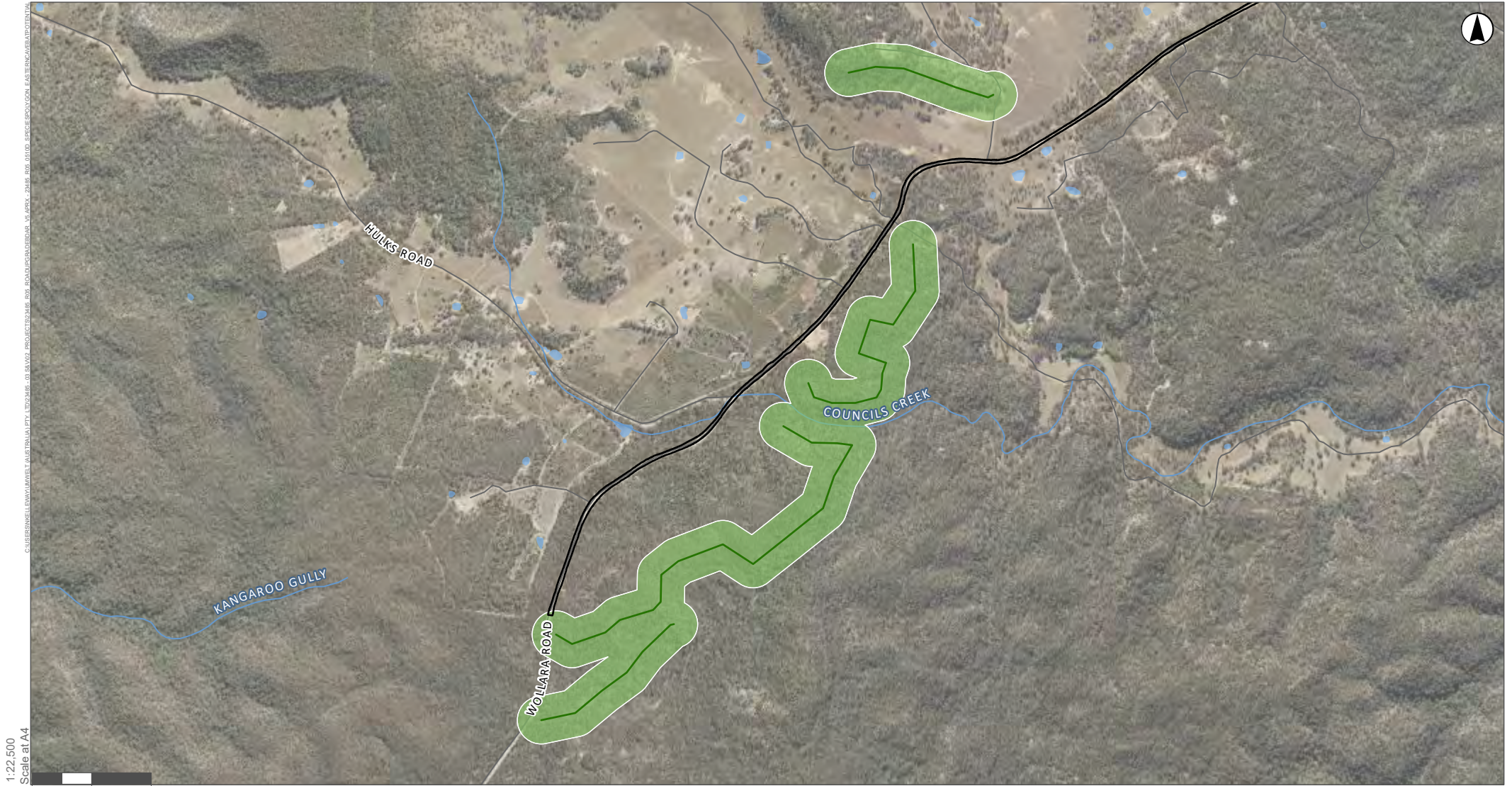
FIGURE 5.10B
Eastern Cave Bat Foraging Habitat Species Polygon



GDA 1994 MGA Zone 56

- Legend**
- Road
 - ▭ Wollara Road Upgrade Development Footprint
 - Waterbodies
 - Eastern Cave Bat Foraging Habitat Species Polygon

FIGURE 5.10C
Eastern Cave Bat Foraging Habitat Species Polygon



1:22,500
Scale at A4

0 0.25 0.5 Kilometres

Legend

- Road
- Watercourse
- Wollara Road Upgrade Development Footprint
- Waterbodies
- Eastern Cave Bat Potential Breeding Habitat (cliff line/rock outcrop)
- Eastern Cave Bat Species Polygon Breeding Habitat

GDA 1994 MGA Zone 56

FIGURE 5.10D
Eastern Cave Bat Potential Breeding Habitat
Species Polygon

5.5.2 Results for BC Act Listed Ecosystem Credit Species

The following ecosystem credit threatened species were observed during surveys:

- Diamond firetail (*Stagonopleura guttata*): Flock of two birds observed within the Wollara Road Upgrade works area on 19 July 2023.
- Brown Treecreeper (eastern subspecies) (*Climacterus picumnus victorie*): Multiple individuals observed adjacent to the works area on 3 and 7 November 2023.
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*): Observed adjacent to and flying over the Wollara Road Upgrade works area on 2, 7 & 8 November 2023, with 1, 4 and 20 observed on the separate observation dates.
- Hooded Robin (*Melanodryas cucullata*): One observed adjacent to the Wollara Road Upgrade works area on 9 August 2023.
- Speckler Warbler (*Chthonicola sagittata*): Two individuals observed within the Wollara Road Upgrade works area on 17 November 2023.

5.5.3 Results for EPBC Act Listed Species

The following EPBC Act listed threatened species were observed during surveys (observation details provided above in **Section 5.3.2**):

- Diamond firetail (*Stagonopleura guttata*).
- Brown Treecreeper (eastern subspecies) (*Climacterus picumnus victorie*)
- Hooded Robin (*Melanodryas cucullata*).

The listings for each of the above species under the EPBC Act was effective from 31 March 2023, which is after the decision on the referral for the Project. All species are also listed under the BC Act and assessed as ecosystem credits under the BAM. Impacts to these species will be offset through the retirement of ecosystem credits in accordance with the BAM. Details of the biodiversity offset obligations and the Project's proposed biodiversity offset strategy can be found in Section 11.

5.6 SEPP (Biodiversity and Conservation) 2021

Chapters 3 and 4 of State Environmental Planning Policy (SEPP) (Biodiversity and Conservation) 2021 (the SEPP) contain provisions for assessing impacts to the Koala for Local Council assessed development applications. This SEPP is not directly relevant to State Significant Development. Chapter 3 of the SEPP has been considered in the identification of potential Koala habitat and breeding habitat to support further assessment under State and Commonwealth legislation.

For RU1 Primary Production zoned land, Chapter 3 Koala Habitat Protection 2020 describes:

- Potential habitat as areas of native vegetation where trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

- Core Koala habitat as area of land with a resident population of Koalas, evidenced by attributes such as breeding females, being females with young, and recent sightings of and historical records of a population.

This assessment of Koala habitat has used the Koala feed tree schedule itemised in both Schedule 1 and Schedule 3 of SEPP (Biodiversity and Conservation) 2021 for the Central Coast Koala Management Area, as the latter provides a comprehensive list of preferred feed trees based on more recent studies.

Eight of the tree species listed in Schedule 3 of the SEPP have been recorded within the Development Footprint. These tree species represent 15% or greater of the total number of trees within any PCT in the Development Footprint and, as such, all PCTs across the Development Footprint represent potential Koala habitat. **Table 5.23** lists the Koala feed trees present within the Development Footprint.

Table 5. Koala Feed Tree Present within Development Footprint

Scientific Name	Common Name
<i>Allocasuarina littoralis</i>	Black She-oak
<i>Angophora floribunda</i>	Rough-barked Apple
<i>Eucalyptus albens</i> *	White Box
<i>Eucalyptus blakelyi</i>	Blakely's Red Gum
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
<i>Eucalyptus fibrosa</i>	Broad-leaved Red Ironbark
<i>Eucalyptus melliodora</i>	Yellow Box
<i>Eucalyptus punctata</i>	Grey Gum

* A *Eucalyptus albens x moluccana* hybrid is likely present within the Development Footprint.

Despite the Development Footprint containing suitable Koala use and feed tree species, no Koalas were observed during surveys and there are no recent or historical records of a population in the areas of the proposed works. As a result, the Development Footprint does not represent core Koala habitat as the Koala was not recorded in the Development Footprint and Koalas have not been recorded nearby (within 5 km) within the last 18 years.

5.7 Identifying Prescribed Impacts

Prescribed impacts are those that may affect biodiversity values in addition to, or instead of, impacts from clearing native vegetation. Clause 6.1 of the Biodiversity Conservation Regulation defines *Prescribed Impacts* as impacts of development on the following habitat of threatened species or ecological communities:

- karst, caves, crevices, cliffs and other geological features of significance
- rocks
- human made structures
- non-native vegetation

- the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- the impacts of development on movement of threatened species that maintains their lifecycle
- the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development)
- the impacts of wind turbine strikes on protected animals
- the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

An assessment which identifies the prescribed impacts which are likely to occur as a result of the proposed development are assessed in **Table 5.24**.

Table 5.24 Prescribed Impacts Identified

Feature	Present	Description of feature characteristics, location and importance	Threatened entities that use, are likely to use, or are part of the habitat feature.
Karst, caves, crevices, cliffs, rocks or other geological features of significance	<input type="checkbox"/> Yes / <input checked="" type="checkbox"/> No	There are no karst, caves, crevices, cliffs, other geological features of significance within the Development Footprint. There are rocks present within the Development Footprint, including surface rocks and some areas of minor rock outcropping.	Threatened reptile species have potential to utilise areas of rocks present.
Human-made structures	<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	There are existing pipes for water flow under the existing road crossings. These pipes have a relatively small diameter, are typically under water and are considered to be unsuitable for threatened species such as microbats.	None identified / do not provide suitable habitat.
Non-native vegetation	<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Areas dominated by exotic vegetation, but assessed as native vegetation are present within the Development Footprint. These habitats are highly degraded.	None identified / do not provide suitable habitat.
Habitat connectivity	<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	The Golden Highway and Bow River to Binks Road Upgrade Development Footprint predominantly adjoins degraded agricultural areas. There is some remnant scattered canopy tree vegetation on the northern side of Killoe Creek which provides a potential habitat connectivity point. This area has already been fragmented by the existing road corridor.	Threatened ecosystem and species credit entities.

Feature	Present	Description of feature characteristics, location and importance	Threatened entities that use, are likely to use, or are part of the habitat feature.
		The Wollara Road Upgrade Development Footprint adjoins areas of native vegetation on both sides of the road which facilitate habitat connectivity with this function expected to be maintained due to the limited and narrow footprint of proposed works.	
Waterbodies, water quality and hydrological processes	<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	<p>The culvert upgrade Development Footprint intersects Killoe Creek which is a 4th order watercourse and Bow River which is a 5th order watercourse. These watercourses are both part of the Goulburn River catchment. There are no estuaries or wetlands located within the Development Footprint.</p> <p>There are various tributaries of Council's Creek which intersect the Wollara Road Upgrade Development Footprint.</p>	Assumed presence has been assessed for the Giant Burrowing Frog in suitable sections of Council's Creek, although the species is not likely to occur as the Development Footprint Area occurs outside of this species natural range.
Wind turbine strikes (wind farm development only)	<input type="checkbox"/> Yes / <input checked="" type="checkbox"/> No	This assessment is not a wind farm development.	Not applicable.
Vehicle strikes	<input type="checkbox"/> No / <input checked="" type="checkbox"/> Yes	The Development Footprint is within an existing road corridor and the works are likely to improve road safety and reduce the potential for vehicle strikes. There is the potential for increased vehicle strikes to fauna, particularly during the construction phase due to increase in vehicle movements. The measures proposed in Section 6 would mitigate against increased vehicle strike.	Reptiles, amphibians, birds and terrestrial mammals.

6.0 Avoid and Minimise Impacts

6.1 Avoid and Minimise Direct and Indirect Impacts

6.1.1 Project Location

6.1.1.1 Location of Surface Works in Areas with No or Low Biodiversity Values

The proposed works are location specific and are related to improvements of existing roads.

6.1.1.2 Location of Sub-Surface Works in Areas with No or Low Biodiversity Values

No sub-surface works are proposed.

6.1.1.3 Avoidance of Wildlife Corridors

The existing road has already fragmented the habitats present, the extent of the proposed road widening is minimal and the project will not increase the current number of lanes.

A route options analysis was undertaken to identify the potential impacts of three site access routes. A detailed description of routes is provided in **Section 6.1.1.6** below. The selected site access via the Golden Highway and Ringwood Road intersection minimises impacts associated with vegetation removal, while providing an efficient transport route to site.

6.1.1.4 Location of Works to Minimise Interactions with Threatened Entities

No threatened species were observed during surveys. A number of species credit species have been assumed to be present within the Development Footprint, with species polygons generated based on the associated PCT and, where relevant, known habitat constraints or microhabitats. Impacts to these species have been minimised through route options analysis which has selected a route which minimises impacts resulting from vegetation clearance while providing an efficient transport route to site. This route analysis is described in more detail within **Section 6.1.1.6** below.

6.1.1.5 Location of Works to Avoid Impacts on Waterbodies and Hydrological Processes

The culvert upgrades required for Golden Highway and Bow River to Binks Road Upgrade Development Footprints have potential to disturb habitats within Killoe Creek and Bow River. These watercourses are both part of the Goulburn River catchment. There are also various tributaries of Council's Creek which intersect the Wollara Road Upgrade Development Footprint.

Changing the location of the works to avoid watercourses is not feasible, as they are upgrading existing crossings. The proposed culverts are expected to improve fish passage at both the Bow River and Killoe Creek watercourse crossing points. The culverts will have a larger diameter compared to the existing causeway, which will be removed, and will be constructed to maintain existing conditions or further replicate the expected natural hydraulic, hydrologic, geomorphic and ecological functions of both watercourses.

The works will include design and control measures to protect against scour and erosion and sediment control and a vegetation management plan will be prepared and implemented for areas of exposed waterfront land which are disturbed by the works.

6.1.1.6 Alternative Routes Considered

A route options analysis was undertaken to assess the most suitable route to the Project site. These three options are detailed further below:

Option 1: Access via the Golden Highway and Ringwood Road intersection is the proposed transport route for the Project. The transport route uses established, predominantly sealed roads with gentle grades and wide carriageways. Intersection upgrades would be required including vegetation removal to provide suitable safe intersection site distance in line with Austroads requirements. Further information is provided in Appendix D of Amendment Report Part A.

Option 2: Access would be via the Golden Highway and Redwell Road intersection. This route was not proposed as it would require road widening and sealing of up to 10 km of road between Redwall Road and Binks Road as well as upgrades to Golden Highway and Redwell Road intersection. Due to capital investment costs, complexity in acquiring land and impacts to biodiversity, this option was not selected as the preferred access route for the Project.

Option 3: Access via Wollar Road and Ringwood Road intersection was not selected as it had numerous environmental and economic constraints and would require an additional travel distance of 107 km via the Golden Highway, Ulan Road and Ulan-Wollar Road. Due to the extended travel time and constraints to safe movements, this option was not selected as the preferred access route for the Project.

The selected site access via the Golden Highway and Ringwood Road intersection minimises impacts such as vegetation clearance while providing an efficient transport route to site. Further information is provided in Appendix D of Amendment Report Part A.

6.1.1.7 Alternative Sites within the Subject Land Considered

There are no alternative sites which would further reduce impacts to biodiversity features as the proposed works are aligned or located directly adjacent to the existing road. Merriwa is identified as the preferred option to house the construction workforce in the Project's Accommodation and Employment Strategy (submitted as part of the Amendment Report, Umwelt 2023), so the majority of Project traffic will be originating northeast of the Project Area.

6.1.1.8 Alternative Project Locations

Alternative Project locations for the Goulburn River Solar Farm have been discussed in a separate BDAR (Umwelt 2023).

6.1.2 Project Design and Planning

6.1.2.1 Alterations to the Development Footprint

The proposed works inclusive of each Development Footprint, reflects a need to increase the road width and provide necessary upgrades to the existing culverts for road safety. Further refinements can be investigated post approval during the detailed design phase.

6.1.2.2 Design Measures

The proposed works have been designed within the alignment of the existing built road and will minimise impacts through confining works to within each Development Footprint.

6.1.2.3 Location of Ancillary Facilities in Areas with No Biodiversity Values, or in Areas of Poorest Habitat

Stockpiles and other ancillary facilities associated with the construction phase of the proposed works will be located within existing disturbed areas. These locations would be determined in consultation with Upper Hunter Shire Council as the road asset owner/landowner.

6.1.2.4 Location of Ancillary Facilities to Avoid Habitat of Threatened Entities

Stockpiles and other ancillary facilities associated with the construction phase of the proposed works will be located within existing disturbed areas to avoid habitat of threatened entities.

6.1.2.5 Actions that Provide for Ecological Rehabilitation, Restoration and/or Maintenance or Retained Areas

Any retained areas within each Development Footprint would be located within an existing road reserve and ecological rehabilitation of these areas is not likely to occur. Ecological rehabilitation will be limited to the replanting of disturbed areas, where appropriate.

6.1.2.6 Alternative Modes or Technologies Considered

Alternative modes or technologies are not of relevance to the proposed development.

6.1.2.7 Project Design Constraints

The project design is primarily constrained by the location of the existing road alignment and Austroad standards. Most changes to the road designs in favour of biodiversity avoidance measures would result in road designs not complying with these standards.

6.2 Avoid and Minimise Prescribed Impacts

Prescribed Impacts are additional impacts which require assessment; however, they are not impacts which require consideration when calculating the number and classes of biodiversity credits required. Prescribed impacts for this Project are identified in **Section 6.0** of this Report. The main prescribed impacts with potential to result from the Project include:

- Impacts to habitat connectivity.
- Impacts to waterbodies, water quality and hydrological processes.
- Vehicle strikes.

Consideration of impact avoidance and minimisation for prescribed impacts is provided as follows.

6.2.1 Project Location

6.2.1.1 Habitat Connectivity

The Golden Highway and Bow River to Binks Road Upgrade Development Footprints predominantly adjoin degraded agricultural areas. There is some remnant scattered canopy tree vegetation on the northern side of Killoe Creek which provides a potential habitat connectivity point. In comparison, the Wollara Road Upgrade Development Footprint adjoins areas of native vegetation on both sides of the road which facilitate habitat connectivity within this area.

Impacts to habitat connectivity have been minimised through the route options analysis which has selected a route which minimises impacts such as vegetation clearance while providing an efficient and safe transport route to site. This route analysis is described in more detail within **Section 6.1.1.6** above. The vegetation surrounding the Development Footprint has already been fragmented by existing roads and proposed works are unlikely to impact substantially on the existing connectivity values. The location of the proposed works cannot be feasibly altered to further avoid prescribed impacts associated with habitat connectivity. All of the proposed Development Footprint assessed within this Report has already been fragmented by the existing roads and the proposed works are not likely to result in any additional significant impacts to habitat connectivity. Whilst the road footprint is being widened, the road will retain close proximity to canopy trees, which will continue to facilitate wildlife movement (i.e., microbats, woodland birds, any potential for gliding mammals).

6.2.1.2 Hydrological Impacts

The location of the proposed works cannot be feasibly altered in response to potential prescribed impacts associated with hydrology.

6.2.1.3 Vehicle Strikes

Each Development Footprint is within an existing road easement and the works are likely to improve road safety and reduce the potential for vehicle strikes by removing the risks associated with unsealed roads. The location of the proposed works cannot be feasibly altered to further avoid prescribed impacts associated with vehicle strikes.

6.2.2 Project Design

6.2.2.1 Habitat Connectivity

The Golden Highway and Bow River to Binks Road Upgrade Development Footprints predominantly adjoin degraded agricultural areas. There is some remnant scattered canopy tree vegetation on the footslopes to the north of Killoe Creek which provides a potential habitat connectivity point. There is also native vegetation adjoining the Wollara Road Upgrade Development Footprint for most of the alignment.

The vegetation surrounding the Development Footprint has already been fragmented by the existing road and the proposed works are unlikely to impact substantially on the existing connectivity values. The location of the proposed works cannot be feasibly altered to further avoid prescribed impacts associated with habitat connectivity.

6.2.2.2 Hydrological Impacts

The road upgrades would be designed with the following design criteria to avoid and minimise impacts associated with alteration to hydrological processes:

- All waterway crossings would be designed and constructed in compliance with the DPI Office of Water (2022a) Guidelines for riparian corridors on waterfront land and DPI Office of Water (2022b) Guidelines for watercourse crossings on waterfront land.
- Appropriate scour protection would be designed for the road repairs and culvert upgrades.
- The road and culvert upgrades would be designed to minimise afflux to an acceptable level.
- The culverts would be designed to accommodate a 5% AEP event.
- Culverts to be constructed at existing invert levels or similar to maintain existing low flow conveyance in channel.

If the upgrades are designed to minimise impacts/afflux to acceptable levels and the design of appropriate erosion and scour protection is undertaken, it is expected that any hydrological impacts as a result of the upgrades works would be negligible. Furthermore, with the implementation of appropriate mitigation measures during construction and operation hydrological impacts as a result of the upgrades works would be negligible. These are further addressed within the EIS.

6.2.2.3 Vehicle Strikes

The Development Footprint is located within an existing road easement. Proposed works are likely to improve road safety and reduce the potential for vehicle strikes by removing the risks associated with unsealed roads. The design of the proposed works cannot be feasibly altered to further avoid prescribed impacts associated with vehicle strikes.

Mitigation measures are proposed to manage fauna strike, as follows:

- Education and awareness raising via site inductions and toolbox talks.
- Speed limits would be enforced on roads through a Traffic Control Plan within the Project Area during construction and operation, to reduce the risk of fauna strikes.
- Native fauna encountered along access tracks during construction and operation would be avoided and vehicles will not continue until the fauna have moved on.
- Fauna Strike Management Procedure to outline reporting and management should a fauna strike from a vehicle occur.

6.3 Other Measures Considered

The proposed works are considered to be a mandatory requirement for the Project to proceed and there are no other feasible options. A number of the proposed upgrades are outside of the direct requirements of the Project and are proposed in response to requests from the UHSC and community to improve road safety in the area. The community will be able to utilise and benefit from the improvements to road safety on an on-going basis once the road upgrades are complete.

Another option considered for the transport route from the south-west of the Project Area via Wollar Road, Ringwood Road and Wollara Road. This option was not chosen as it would result in a longer travel time for the workforce which is proposed to be located in and around Merriwa and have greater environmental impacts. Additionally, the option from the south-west would require more extensive upgrades to the existing road infrastructure.

6.4 Summary of Measures to Avoid and Minimise Impacts

A summary of the measures proposed to avoid and minimise direct, indirect and prescribed impacts associated with the proposal is provided in **Table 6.1**.

Table 6.1 Avoidance and Minimisation Measures for Direct, Indirect and Prescribed Impacts

Action	Outcome	Timing	Responsibility
Location and design of works in existing disturbed areas where possible	The proposed works have been aligned to existing disturbed areas where possible and respond to the existing road alignment.	Project design	Project Ecologist, Planning Team and Proponent
Workforce education and training	Environmental awareness for workforce.	Pre-construction and during construction and operation	Site Manager
Implement Construction Environmental Management Plan (CEMP)	Management and minimisation of potential environmental impacts.	Construction	Site Manager
Implementation of vegetation protection zones for areas to be retained	Protect retained habitats.	Construction	Project Ecologist and Site Manager
Ecologist pre-clearance surveys and supervision of works	Minimisation of impacts to local fauna and their habitats through identification of fauna present and management to minimise harm.	Construction / site clearing phase	Project Ecologist and Site Manager
Fencing and access control	Site access controls and temporary fencing or similar would be implemented to prevent unauthorised site access and disturbance.	Construction	Site Manager
Erosion and sedimentation control	Minimise erosion and sedimentation within the site and downstream habitats through installation and maintenance of erosion and sediment controls and water quality infrastructure.	Construction	Site Manager
Weed management	Prevent weed incursions and spread.	Construction	Site Manager

7.0 Impact Assessment

7.1 Direct Impacts

7.1.1 Residual Direct Impacts

The Development Footprint which would be impacted by the proposed works are mapped in **Figure 1.5**, **Figure 1.6** and **Figure 1.7** and the areas of PCTs to be impacted are mapped in **Figure 4.3** and **Figure 4.4**. **Table 7.1** summarises the extent of proposed residual direct impacts to plant community types and threatened entities observed or assumed to be present.

Table 7.1 Summary of Residual Direct Impacts

IBRA Subregion	Direct impact	BC Act status	EPBC Act status	Potential SAI entity	Project phase/timing of impact	Extent (ha)
Liverpool Range	PCT 483 Vegetation Condition Zone 1 Remnant Trees	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC (where condition threshold is met)	Yes	Site clearing	0.20
	PCT 483 Vegetation Condition Zone 2 Exotic Dominated Grassland	This Vegetation Condition Zone contains exotic dominated grassland areas which are likely to have historically supported the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC, however are considered to too degraded to be identifiable as part of this CEEC.	Not listed	No	Site clearing	3.12
	PCT 1691 Vegetation Condition Zone 3 Remnant Trees	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	Yes	Site clearing	0.09

IBRA Subregion	Direct impact	BC Act status	EPBC Act status	Potential SAI entity	Project phase/timing of impact	Extent (ha)
Kerrabee	PCT 3334 Vegetation Condition Zone 4 Roadside Remnant Forest	Not listed	Not listed	No	Site clearing	0.04
	PCT 3388 Vegetation Condition Zone 5 Roadside Remnant Forest	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	Yes	Site clearing	0.36
	PCT 3781 Vegetation Condition Zone 6 Roadside Remnant Forest	Not Listed	Not Listed	No	Site clearing	1.05

7.1.2 Change in Vegetation Integrity Score

For each Vegetation Condition Zone the change in vegetation integrity is based on the development impacting to zero during construction. There are no vegetation integrity scores above zero after development and there would be no management actions required to maintain any remaining vegetation as it has been assumed that impact would occur to all vegetation within the Vegetation Condition Zones. Details of impacts to vegetation integrity for each Vegetation Condition Zone are shown in **Table 7.2**.

Table 7.2 Impacts to Vegetation Integrity

IBRA Subregion	PCT and Vegetation Condition Zone	Management zone	Area (ha)	Before development				After development				Change in VI score
				Composition	Structure	Function	VI score	Composition	Structure	Function	VI score	
Liverpool Range	PCT 483 Vegetation Condition Zone 1 Remnant Trees	Impact Footprint	0.20	74.2	89.1	96.7	86.1	0	0	0	0	-86.1
	PCT 483 Vegetation Condition Zone 2 Exotic Dominated Grassland	Impact Footprint	3.12	12.9	5	15	9.9	0	0	0	0	-9.9
	PCT 1691 Vegetation Condition Zone 3 Remnant Trees	Impact Footprint	0.09	57.8	93.4	58	67.9	0	0	0	0	-67.9
Kerrabee	PCT 3334 Vegetation Condition Zone 4 Roadside Remnant Forest	Impact Footprint	0.04	40.9	78.3	74.7	62.1	0	0	0	0	-62.1
	PCT 3388 Vegetation Condition Zone 5 Roadside Remnant Forest	Impact Footprint	0.36	62.3	46	48.6	51.8	0	0	0	0	-51.8
	PCT 3781 Vegetation Condition Zone 6 Roadside Remnant Forest	Impact Footprint	1.05	82.4	74.6	86.8	81.1	0	0	0	0	-81.1

7.2 Indirect Impacts

Table 7.3 summarises the extent of the proposed residual indirect impacts to PCTs and threatened entities observed or assumed to be present across the three parts of the Development Footprint.

Table 7.3 Summary of Residual Indirect Impacts

Indirect impact	Threatened Entity Impacted	Project Impact Intensity	Frequency / Duration	Project phase/ timing of impact	Likelihood and consequences
Connectivity and corridors	No threatened entities are likely to be substantially impacted by connectivity and corridor impacts.	Low	One-off / Ongoing	Ongoing	None as the works are aligned to an existing road corridor.
Light spill impacts	No threatened entities are likely to be impacted by light spill.	Nil	N/A	N/A	Road upgrade to occur during standard construction hours. No night work is required.
Noise and vibration impacts	Noise and vibration impacts are likely to be insignificant to threatened species as the works are aligned to an existing road.	Low	Frequent / short term	During construction works	Likely to occur during works, but will be limited to the existing road corridor.
Air quality impacts	No threatened entities are likely to be impacted.	Low	Infrequent / short term	During construction works	The works are likely to improve air quality impacts for the Wollara Road Upgrade Development Footprint as the existing dirt road will be sealed.
Water impacts	Non identified.	Low	Infrequent / short term	During construction works	Road upgrades would be designed to avoid and minimise impacts associated with alterations to hydrological processes. Road upgrades would be appropriately designed and as such it is expected that any hydrological impacts as a result of the upgrades works would be negligible.
Weed invasion	Low potential to impact Box Gum Woodland CEEC and habitats generally for species credit entities with assumed presence and predicted presence / ecosystem credit species.	Low	Infrequent / short term	During construction works	The works have a low potential to spread weeds during works. Suitable mitigation measures will be employed to limit weed spread.

7.3 Prescribed Impacts

Prescribed impacts associated with the proposal are identified in **Section 6.0** of this report and are further documented below.

7.3.1 Human Made Structures

7.3.1.1 Nature and Extent

There are existing small diameter pipes under the Bow River and Killoe Creek road crossings located within the Golden Highway and Bow River to Binks Road Upgrade Development Footprints. These would be replaced during works. The pipes do not provide habitat for fauna species due to their small size and increase risk of predation and complete inundation.

7.3.1.2 Duration

This is likely to be a one-off, permanent impact.

7.3.1.3 Consequences

No threatened species are likely to utilise these habitats and no significant consequences are predicted to occur.

7.3.2 Non-Native Vegetation

7.3.2.1 Nature and Extent

Non-native vegetation has been assessed against PCT 483 as a low cover of native species is present. Areas dominated by exotic vegetation to be impacted include 3.12 ha across the Development Footprint.

7.3.2.2 Duration

This is likely to be one-off, permanent impact.

7.3.2.3 Consequences

No substantial impacts to threatened biodiversity is likely to occur.

7.3.3 Habitat Connectivity

7.3.3.1 Nature and Extent

The Golden Highway and Bow River to Binks Road Upgrade Development Footprints predominantly adjoin degraded agricultural areas. There is some remnant scattered canopy tree vegetation on the northern side of Killoe Creek which provides a potential habitat connectivity point. In comparison, the Wollara Road Upgrade Development Footprint adjoins areas of native vegetation on both sides of the road which facilitate habitat connectivity within this area.

The Development Footprint has already been fragmented by existing roads and the proposed works are unlikely to impact substantially on the existing connectivity values. The location of the proposed works cannot be feasibly altered to further avoid prescribed impacts associated with habitat connectivity. Whilst the road footprint is being widened, the road will retain close proximity to canopy trees, which will continue to facilitate wildlife movement (i.e., microbats, woodland birds, any potential for gliding mammals).

7.3.3.2 Duration

This is likely to be one-off, permanent impact.

7.3.3.3 Consequences

There are not likely to be any predictable or substantial consequences associated with impacts to existing habitat connectivity and the proposed works are not likely to prevent movement of threatened species that maintains their lifecycle.

7.3.4 Waterbodies, Water Quality and Hydrological Processes

7.3.4.1 Nature and Extent

The road upgrades would be designed in accordance with design criteria to avoid and minimise impacts associated with alteration to hydrological processes as detailed in **Section 6.2.2.2** above. If the upgrades are designed to minimise impacts/afflux to acceptable levels and the design of appropriate erosion and scour protection is undertaken, it is expected that any hydrological impacts as a result of the upgrades works would be negligible.

7.3.4.2 Duration

Watercourse impacts would occur during construction.

7.3.4.3 Consequences

The road upgrades will be designed to minimise impacts/afflux to acceptable levels and the design of appropriate erosion and scour protection will be undertaken. As such it is expected that any hydrological impacts as a result of the upgrades works would be negligible.

7.3.5 Vehicle Strikes

The number of vehicle movements would temporarily increase during the Project's construction period. This may temporarily increase vehicle strikes during this period. Vehicle movement during operational phase is not expected to increase, therefore, additional vehicle strikes are unlikely during this phase of the Project due to road safety upgrades and removal of risk associated with gravel roads.

7.3.6 Karst, Caves, Crevices, Cliffs, Rocks and other Geological Features

7.3.6.1 Nature and Extent

Rocky areas are present in a few locations within and adjoining the Liverpool Range Assessment Area Development Footprint and the Kerrabee Assessment Areas Development Footprint is located on mostly shallow sandstone bedrock material with multiple areas of exposed rock but no substantial habitat features such as caves or crevices.

7.3.6.2 Duration

This is likely to be a one-off, permanent impact.

7.3.6.3 Consequences

There is low potential for threatened reptiles to utilise these habitats and no significant consequences are predicted to occur due to the small footprint of the proposed works, proposed mitigation measures and extensive areas of adjoining higher quality habitats.

7.4 Mitigating Residual Impacts – Management Measures and Implementation

The following management measures are proposed to mitigate the residual impacts (direct, indirect and prescribed) associated with the Project. The impact mitigation measures proposed for residual impacts are also further summarised in **Table 7.4**, with implementation details provided in **Table 7.5**.

7.4.1 Workforce Education and Training

The ability of non-ecological personnel to identify key threatened species or key ecological threats can help to mitigate impacts on threatened species. The following mitigation actions would be implemented for the Project to develop a greater understanding and awareness of biodiversity issues in non-ecological trained personnel:

- Inductions for the workforce would be undertaken to make them aware of the key ecological issues present across the Development Footprint to aid in their understanding of their role and responsibilities in the protection and/or minimisation of impacts to all native biodiversity.
- Inductions would identify the location of sensitive flora and fauna, including any defined exclusion/no-go areas, and the policies being implemented to protect the biodiversity values of such areas.
- Responsibilities with respect to weed management and biosecurity.

7.4.2 Implementation of Vegetation Protection Zones for Areas to be Retained

During construction, temporary exclusion fencing or another form of suitable marking measure, would be used to demarcate vegetation in locations where necessary to avoid accidental damage to areas of vegetation to be retained. Access control is an important feature in protecting and demarcating areas outside the Development Footprint from vehicle access, human access, and accidental disturbance. Proposed measures include:

- Appropriate temporary fencing (or other form of suitable marking measures) and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance and to minimise vehicular and human traffic.
- Clear and visible signage is to be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the Development Footprints.
- Worker education and awareness of exclusion areas, including as delivered through site induction information.

7.4.3 Ecologist Pre-Clearance Surveys and Supervision of Works

Pre-clearance surveys and tree felling supervision would be undertaken by an appropriately qualified and experienced ecologist to minimise potential impacts to fauna species, particularly hollow-dependent fauna. A detailed tree-felling supervision protocol is to be developed and documented as part of the CEMP for the works.

7.4.4 Erosion and Sedimentation Control

Erosion and sediment controls are to be implemented for the works and broadly include:

- Minimising the area of disturbance (as far as practicable).
- Diverting run-off water around disturbed areas.
- Installation and ongoing maintenance of temporary erosion and sediment controls (e.g., sediment fencing) throughout the duration of the works.
- Stabilisation (i.e., landscaping and revegetation) of all disturbed areas.

Additional mitigation measures relating to erosion and sediment control are detailed within the EIS.

7.4.5 Weed Management

Weed species could be introduced to the Development Footprint or surrounding habitats with imported materials, on vehicles and mobile plant, or could invade naturally through removal of native vegetation and the creation of a suitable growth medium. The presence of weed species has the potential to decrease the value of vegetation for native species, particularly threatened species.

Weed management controls would include:

- The survey and treatment of invasive weed species prior to the disturbance of topsoil within the Development Footprints to prevent exacerbation of the outbreak and / or the spread of the subject species to previously unaffected areas within the Development Footprints.
- Ongoing environmental inspections and treatment of outbreaks of invasive weed species as required across all Development Footprints during construction.
- All machinery and equipment would be cleaned thoroughly prior to entering the Development Footprints. Cleaning must include the removal of all mud and plant matter (inside and out), followed by washing with high pressure water.

7.4.6 Preparation and Implement of Construction Environmental Management Plan

A CEMP or similar management plan would be prepared for the Project to document the environmental impact mitigation, performance targets and monitoring requirements for the construction phase of the Project.

Table 7.4 Summary of Proposed Mitigation and Management Measures for Residual Impacts (Direct, Indirect, and Prescribed)

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy
Workforce education and training	Environmental awareness for construction and operational site workers	Construction and operation	For all new contractors and employees as part of the general site induction	Site Manager	Measure is likely to achieve intended outcome
Implementation of vegetation protection zones for areas to be retained	Establishment of no-go zones prior to vegetation clearing	Construction / site clearing	Prior to and during clearing and construction works	Site Manager and Project Ecologist	Measure is likely to achieve intended outcome
Ecologist pre-clearance surveys and supervision of works	Minimisation of impacts to local fauna and their habitats through identification of fauna present and management to minimise harm.	Construction	Prior to and during site clearing	Site Manager and Project Ecologist	Measure is likely to achieve intended outcome
Erosion and sedimentation control	Installation and maintenance of appropriate erosion and sediment controls and work practices.	Construction, operation and decommissioning	Temporary erosion and sediment controls would be installed prior to commencement of construction and maintained for the duration of the works	Site Manager	Measure is likely to achieve intended outcome
Weed management	Targeted spraying to suppress new weed invasions	Construction, operation and decommissioning	As needed	Site Manager / Project Ecologist	Measure is likely to achieve intended outcome
Preparation and implementation of CEMP	Develop plan to document and coordinate environmental mitigation measures during construction works.	Pre-construction	During works	Upper Hunter Shire Council	Measure is likely to achieve intended outcome

Implementation details for the proposed impact mitigation and management measures are provided in **Table 7.5**.

Table 7.5 Implementation Details for Proposed Impact Mitigation and Management Measures

Measure/action	Monitoring and evaluation strategy	Performance criteria	Adaptive management threshold	Adaptive management response
Workforce education and training	Completion and maintenance of a site induction register.	Induction of all construction workers.	Failure of Site Manager to induct workers.	Suspension of the relevant works until construction workers are inducted.
Implementation of vegetation protection zones for areas to be retained	Monitoring to be undertaken by the Project Ecologist prior to commencement.	Establishment of no-go zones around vegetation to be retained. Establishment of a vegetation clearing permit protocol to reduce the risk of unauthorised clearing.	Clearing of vegetation within no-go zones. Clearing of vegetation without an approved clearing permit (unauthorised clearing).	Suspension of the relevant works until appropriate protection measures are implemented and appropriate remedial actions to remedy any adverse impacts are commenced. Breaches to be reported in annual compliance reporting to DPE.
Ecologist pre-clearance surveys and supervision of works	Reporting on preclearance surveys and works supervision to be undertaken by Project Ecologist.	Clearing of all native vegetation to be overseen by project ecologist.	Clearing of native vegetation without Project Ecologist supervision.	Suspension of relevant works until Project Ecologist supervision is available. Breaches to be reported in annual compliance reporting to DPE.
Erosion and sedimentation control	Monitoring to be undertaken in accordance with requirements of CEMP.	Temporary erosion and sediment controls to be installed prior to works.	Monitoring detects lack or failure of required temporary or permanent erosion and sediment controls.	Erosion and sediment control issues are to be rectified or altered to improve.
Weed management	Monitoring to be undertaken in accordance with requirements of CEMP.	Weed growth to be continually suppressed within the development footprint.	Monitoring detects increasing weed infestations which are not being suppressed.	Alternative methods or herbicides to be used to achieve success.
Preparation and implementation of CEMP	Implementation to be supervised by Project Ecologist or suitable environmental consultant with regular reporting to DPE during construction.	Completion of all proposed environmental protection works and monitoring inspections.	Monitoring detects breach or failure to implement CEMP.	Breach to be included in annual compliance reporting to DPE.

7.5 Adaptive Management Strategy for Uncertain Impacts (Where Relevant)

It is considered that the potential impacts associated with the Project are predictable and known. Adaptive strategies for impact mitigation measures are provided in **Table 7.5**. Further adaptive management strategies would be provided in a future CEMP which would be prepared for the Project.

8.0 Serious and Irreversible Impacts

8.1 Assessment for Serious and Irreversible Impacts on Biodiversity Values

The determination of a serious and irreversible impact on biodiversity values is to be made by the decision maker in accordance with the principles set out in the BC Regulation 2017. Under Clause 6.7 (2) of the BC Regulation 2017, an impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because of one of the following four principles:

- Principle 1: The impact will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- Principle 2: the impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- Principle 3: it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- Principle 4: the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

The proposed works would impact on the following serious and irreversible impact (SAIL) entities:

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions.
- *Commersonia rosea (Androcalva rosea)*.
- Regent Honeyeater (*Anthochaera phrygia*).
- Broad-headed Snake (*Hoplocephalus bungaroides*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Eastern Cave Bat (*Vespadelus troughtoni*).

8.1.1 Additional Impact Assessment Provisions for TECs at Risk of an SAI

8.1.1.1 White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions

The additional impact assessment provisions for threatened ecological communities at risk of an SAI have been addressed for the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community (Box Gum Woodland CEEC) in **Table 8.1**. The location of the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC within the Development Footprint is shown in **Figure 4.5A–F** and **Figure 4.6A–C**. This ecological community is listed as critically endangered under the BC Act and the EPBC Act.

Table 8.1 SAI Impact Assessment – White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC

Response to BAM Section 9.1.1 Criteria	
1. The action and measures taken to avoid the direct and indirect impact on the TEC at risk of an SAI (or reference to where these have been addressed in the relevant section of the BDAR).	The actions and measures proposed to avoid direct and indirect impacts are documented in Section 6.0 of this Report. Principally, a route options analysis has been carried out which has selected a route that minimises impacts to vegetation, including White Box – Yellow Box – Blakey's Red Gum Grassy Woodland and Derived Native Grassland while providing an efficient and safe transport route to site. This route analysis is described in more detail within Section 6.1.1.6 above.
2. The assessor must consult the TBDC and/or other sources to report on the current status of the TEC including:	
a. Evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the TEC in NSW and the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)	
b. The extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes (Principle 2, clause 6.7(2)(b) BC Regulation) indicated by:	
i. Change in community structure	
ii. Change in species composition	
iii. Disruption of ecological processes	
iv. Invasion and establishment of exotic species	
v. Degradation of habitat	
vi. Fragmentation of habitat	
c. Evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the TEC's geographic range in NSW according to the:	
i. extent of occurrence	
ii. area of occupancy	
iii. number of threat defined locations.	
d. Evidence that the TEC is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation).	
	The TBDC has been reviewed in relation to the information available for the Box Gum Woodland CEEC. Additional sources relied upon are referenced within the text below.

Response to BAM Section 9.1.1 Criteria

a. The current extent of the Box Gum Woodland CEEC and the estimated reduction in the geographic extent since 1970 is not available in the TBDC.

Threatened Species Scientific Committee

An assessment completed by TSSC (2006) and reproduced by the NSW Threatened Species Scientific Committee (2020) estimates that the pre-1750 area of the Box Gum Woodland CEEC was 3,717,366 ha, which has been reduced to a current extent in 2020 of 250,729 ha. This represents a 93% reduction since 1750 and represents the existing intact woodland components of the ecological community. A larger extent of the derived native grassland component of the community is expected to remain.

State Vegetation Type Map

Umwelt has utilised the current available State Vegetation Type Mapping (SVTM) which identifies an estimate of the per 1750 and current extent of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland using the best currently available mapping. The SVTM pre-1750 area of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC is between 1,895,058 ha and 2,403,693 ha and the current SVTM extent of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland is between 1,267,603 ha and 1,639,571 ha. The variance in the SVTM upper estimate is due to some mapped PCTs being identified as only partly being associated with the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC.

Annual Loss and Reduction in Extent Since 1970

NSW Threatened Species Scientific Committee (2020) have identified that the loss of the woodland component of Box Gum Woodland CEEC between 2009 and 2019 was 6653 ha or 665.3 ha per annum distributed disproportionately between years. Using this figure, an estimate of the loss over the 1970 to 2020 period of 33,265 ha of the woodland component of the CEEC has been obtained. However, it is considered the rate of loss prior to 2009 is likely to have been much greater than 550 ha per annum due to a non-linear rate of clearing attributed to less legislative restrictions protecting Box Gum Woodland prior to its listing.

b. The following information has been obtained from the Conservation Assessment of the Box Gum Woodland CEEC prepared by the NSW Threatened Species Scientific Committee (2020).

Changes in community structure

In relation to community structure there are essentially no remaining areas that are fully intact and most of the remaining extent has lost its understory, been invaded by exotic species, lost entire suites of species or lost its structure in terms of the loss of tree, shrub and/or ground layers.

Changes in species composition

Species composition has been adversely affected by degradation and fragmentation which has caused the loss of suites of species such as understorey components or faunal components such as reptiles, mammals and/or woodland birds. The species lost are sometimes replaced by more common species such as aggressive noisy miners, exotic flora or monocultures of native grasses.

Disruption of ecological processes

The ecological community has undergone or is likely to undergo within a time frame appropriate to the life cycle of the habitat characteristics of its component species a very large disruption of biotic processes or interactions. The changes have been such that reestablishment of the ecological processes, species composition and community structure of the original ecological community is not likely to be possible on a broad scale.

Invasion and establishment of exotic species

Weeds have invaded most of the remaining areas of the original pre-1750 extent of this ecological community and result in continuing detrimental change. Extensive areas have experienced elevated soil nitrogen as a result of the application of chemical fertilisers, which is associated with the invasion of weeds and eventual conversion of native to exotic pasture.

Response to BAM Section 9.1.1 Criteria

Degradation of habitat

The ecological community continues to be degraded at both the patch and landscape scale. This ongoing modification, while not necessarily leading to the destruction of all elements of the ecological community, threatens it with extinction. Cumulatively, the disruption of biotic processes and interactions caused by the implementation of management for agricultural production is very severe and less than 10% of the original distribution of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland is likely to have avoided the long-term impacts of pastoralism.

Fragmentation of habitat

The ecological community has been extensively cleared throughout its range and intact remnants are typically small, isolated, highly fragmented and occur in predominantly cleared landscapes and exhibit highly modified understoreys.

c. The extent of occurrence of Box Gum Woodland throughout its entire range in Australia is identified by the NSW Threatened Species Scientific Committee (2020) as 702,800 km², this is likely to predominantly include areas with an intact tree layer. The extent of occurrence within NSW is not identified in the TBDC or separately assessed by the NSW Threatened Species Scientific Committee (2020).

The current geographic extent of this CEEC across its range is estimated by the NSW Threatened Species Scientific Committee (2020) (reproduced from TSSC 2006) as 576,654 ha, which includes an area of occupancy of 250,729 ha within NSW. This estimate does not include the derived native grassland component of the ecological community.

No threat defined locations are specifically identified in the TBDC profile, however the ecological community is listed under the BC Act as critically endangered across its distribution.

It is noted the Development Footprint contains a potentially unique form of the CEEC which is dominated by an intergrade of *Eucalyptus albens* (White Box) and *Eucalyptus moluccana* (Grey Box) - informally known as *Eucalyptus 'albemol'*. This formation appears to be regionally restricted to the Merriwa region.

d. This principle is not applicable to the Box Gum Woodland CEEC. The ecological community does respond to management, with some successful management measures are outlined in the document titled 'A Guide to Managing Box Gum Grassy Woodlands' (Rawlings, Freudenberger and Carr 2010).

While not directly relevant to the Project the following management actions are also listed within the TBDC:

- Undertake control of rabbits, hares, foxes, pigs and goats (using methods that do not disturb the native plants and animals of the remnant).
- Manage stock to reduce grazing pressure in high quality remnants (i.e., those with high flora diversity or fauna habitat).
- Do not harvest firewood from remnants (this includes living or standing dead trees and fallen material).
- Leave fallen timber on the ground.
- Erect on-site markers to alert maintenance staff to the presence of a high-quality remnant or population of a threatened species.
- Encourage regeneration by fencing remnants, controlling stock grazing and undertaking supplementary planting, if necessary.
- Undertake weed control (taking care to spray or dig out only target species).
- Protect all sites from further clearing and disturbance.
- Ensure remnants remain connected or linked to each other; in cases where remnants have lost connective links, re-establish them by revegetating sites to act as steppingstones for fauna, and flora (pollen and seed dispersal).
- Mark remnants onto maps (of the farm, shire, region, etc) and use to plan activities (e.g., remnant protection, rehabilitation or road, rail and infrastructure maintenance work). On-site markers can alert maintenance staff to the presence of a threatened species.

Response to BAM Section 9.1.1 Criteria
<p>3. Where the TBDC indicates that data is ‘unknown’ or ‘data deficient’ for a TEC for a criterion listed in Section 9.1.1(2), the assessor must record this in the BDAR.</p>
<p>The NSW Box Gum Woodland CEEC is not identified as ‘unknown’ or ‘data deficient’ in the TBDC, although the full extent and condition of the derived native grassland component of the ecological community has not been determined across its distribution.</p>
<p>4. The following questions are addressed in relation to the impacts from the proposal of the TEC.</p> <p>a. The impact on the geographic extent of the TEC (Principles 1 and 3) by estimating the total area of the TEC to be impacted by the proposal:</p> <ol style="list-style-type: none"> i. in hectares ii. as a percentage of the current geographical extent of the TEC in NSW <p>b. the extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes (Principle 2) of the TEC by:</p> <ol style="list-style-type: none"> i. estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 m of the development footprint or equivalent area for other types of proposals ii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by: <ul style="list-style-type: none"> - distance between isolated areas of the TEC, presented as the average - distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and - estimated maximum dispersal distance for native flora species characteristic of the TEC, and - other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development iii. Describing the condition of the TEC according to the vegetation integrity score for the relevant Vegetation Condition Zone (s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each Vegetation Condition Zone.
<p>a. The proposed works assessed within this Report would impact approximately 0.65 ha of this CEEC, comprising:</p> <ul style="list-style-type: none"> • PCT 483 Vegetation Condition Zone 1 - Remnant Trees (0.20 ha). • PCT 1691 Vegetation Condition Zone 3 - Roadside Remnant Forest (0.09 ha). • PCT 3388 Vegetation Condition Zone 5 – Remnant Forest (0.36 ha). <p>The Project would impact between 0.0003% of the geographic extent of this CEEC mapped by the TSSC (2006). The 0.65 ha of the CEEC impacted is comprised of scattered remnant trees with generally sparse mid-story and mixed understorey, with some areas dominated by native species, and other areas containing high densities of exotic species.</p> <p>b. The Project would not isolate any areas of the Box Gum Woodland CEEC as the works are located within an existing road reserve. The proposed road widening works have the potential to increase the isolation distance at a patch of vegetation along Ringwood Road from approximately 15 m to 30 m. The increase in isolation distance is considered unlikely to have a notable impact on connectivity.</p> <p>The main dispersal mechanisms for flora species associated with the Box Gum Woodland CEEC are inferred to be by one or a combination of dispersal mechanisms, including animals, wind, water runoff, and gravity. Eucalypts within the Box Gum Woodland CEEC are likely to rely on animal assisted dispersal by highly mobile vertebrate pollinators (birds and bats) which disperse pollen over large areas when foraging (Southerton <i>et al.</i> 2004). The maximum dispersal distance for native flora species characteristic of the Box Gum Woodland ecological community is estimated to be at least 1,000 m and potentially much further.</p> <p>The Project is not likely to increase the area to perimeter ratio of the remaining areas of this TEC, as the Development Footprint is situated within an existing linear road reserve.</p>

Response to BAM Section 9.1.1 Criteria					
<p>Within the Development Footprint, areas of the Box Gum Woodland CEEC correspond to three PCTs and vegetation condition zones which adjoin existing agricultural land and have been variably impacted by weed invasion. A summary of the relevant composition, structure and function condition scores for each Vegetation Condition Zones is provided below.</p>					
Vegetation Condition Zone	Area impacted (ha)	Current VI score	Composition score	Structure score	Function score
PCT 483 Vegetation Condition Zone 1 - Remnant Trees	0.20	86.1	74.2	89.1	96.7
PCT 1691 Vegetation Condition Zone 3 - Roadside Remnant Forest	0.09	67.9	57.8	93.4	67.9
PCT 3388 Vegetation Condition Zone 5 – Remnant Forest	0.36	51.8	62.3	46	51.8
<p>Areas of exotic dominated grassland have also been assessed against PCT 483 which occupy an area of 3.12 ha within the Development Footprint. These areas have a vegetation integrity score of 9.9 and are considered to not represent this CEEC.</p>					
<p>5. The assessor may also provide new information that demonstrates that the principle identifying that the TEC is at risk of an SAI is not accurate.</p>					
<p>It is considered that there is no other information of relevance identifying that the Box Gum Woodland CEEC is not at risk of an SAI.</p>					

8.1.2 Additional Impact Assessment Provisions for Threatened Species at Risk of an SAI

8.1.2.1 *Commersonia rosea* (*Androcalva rosea*)

The additional impact assessment provisions for *Commersonia rosea* (*Androcalva rosea*) in **Table 8.2**. The location of the *Commersonia rosea* (*Androcalva rosea*) species polygon within the Development Footprint is shown in **Figure 5.1**. This species is listed as endangered under the BC Act and the EPBC Act.

Table 8.2 SAI Impact Assessment – *Commersonia rosea* (*Androcalva rosea*)

Response to BAM Section 9.1.2 Criteria
<p>1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAI, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAI. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.</p>
<p>Measures proposed to avoid direct and indirect impacts on this species are documented in Section 7.0 of this report. Principally, a route options analysis has been carried out which has selected a route that minimises impacts to vegetation, including habitat for <i>Commersonia rosea</i> (<i>Androcalva rosea</i>), while providing an efficient transport route to site. This route analysis is described in more detail within Section 6.1.1.6 above. This species has been assessed via assumed presence and the species polygon for this species is mapped in Figure 5.1.</p>

Response to BAM Section 9.1.2 Criteria

2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:

- a. Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:**
 - i. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or
 - ii. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites
- b. Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:**
 - i. An estimate of the species' current population size in NSW, and
 - ii. An estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and
 - iii. Where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations
- c. Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:**
 - i. Extent of occurrence
 - ii. Area of occupancy
 - iii. Number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and
 - iv. Whether the species' population is likely to undergo extreme fluctuations
- d. Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:**
 - i. Known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., Species is clonal) on, a biodiversity stewardship site
 - ii. The species is reliant on abiotic habitats which cannot be restored or replaced (e.g., Karst systems) on a biodiversity stewardship site, or
 - iii. Life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., Frogs severely impacted by chytrid fungus).

The TBDC has been reviewed in relation to the information available *Commersonia rosea*. Additional sources relied upon are referenced within the text below.

2ai. The TBDC does not detail population data for *Commersonia rosea*. No published data is available for the species regarding population decline across 10 years or three generations to inform population data for this criterion.

2a.ii. No published data is available for the species regarding population decline across 10 years or three generations to inform population data for this criterion.

2bi. *Commersonia rosea*, was first described in 2004 Bell & Copeland (2004). The species was thought to have a highly restricted population within the Upper Hunter Valley, originally known from four locations in the Sandy Hollow region. These populations collectively were estimated as consisting of less than 200 plants (Bell & Copeland 2004). However, contrary to this first observation, a paper published by Bell (2021), observed new populations of *Commersonia rosea* in post fire surveys within Wollemi National Park and Goulburn River National Park. During these surveys, the species were reportedly the dominant ground-cover species, existing in their thousands during this survey. Bell (2021) also suggests that more of this species was likely present, in areas absent from survey.

Response to BAM Section 9.1.2 Criteria

This more recent evidence of *Commersonia rosea*, suggests that the species is far more abundant and more widespread than first reported (Bell 2021).

2bii. Umwelt reviewed the scientific literature and available information. No published data is available to inform this criterion.

2biii. *Commersonia rosea* is considered a disturbance specialist, more specifically a fire ephemeral species, meaning that the species emerges following fire and the species relies on fire for germination (Bell 2021). Given the nature of the species ecology, fluctuations and dormancy during different life stages are given. Species such as this are known to be difficult to measure in conservation assessments without fully understanding their ecology.

2ci. *Commersonia rosea*, when first described was known as several populations within the Upper Hunter Region of NSW, these locations are centred around the Sandy Hollow district, one population south-east of Sandy Hollow and another population within the Goulbourn River National Park (Bell & Copeland 2004; DoE 2014). Post fire monitoring surveys in 2015 identified the species occupying adjacent areas within the Wollemi National Park and Goulburn River, which was reported as a 30 km range extension from the original species description (Bell 2021).

2cii. The TBDC states the area of occupancy for the species is < 50 individuals or < 250 individuals where threats are known.

2ciii. No information has been included in the TBDC for this criterion. The original description of the species recommends the species as having a ROTAP 2E (following Briggs & Leigh 1996), meaning 2= occurring over a range of less than 100 km and E = in serious risk of disappearing from the wild in the next few decades if present land use and other casual factors continue to operate (Bell & Copeland 2004). The approved conservation advice for the species DoE (2014) states that the species population estimate is 300 individuals. However more recent evidence from the 2021 publication from Bell (2021) described the species as occurring within its thousands, following fire.

2civ. As identified above, the species is a fire ephemeral species, meaning that the species emerges following fire and the species relies on fire for germination (Bell 2021). Given the nature of the species ecology, fluctuations will be inevitable, given its ecology.

2di. Given the highly specialised nature of the species ecology in particular the reproductive strategy, it would be acceptable to imply that this would limit the existing population on or to occupy new habitat.

2dii. Umwelt reviewed the scientific literature and available information. No published data is available to inform this criterion.

2diii. The TBDC does not detail key threatened processes for the species. Bell (2021) recommends that given the species perseverance of the species following fire, that no real threats appear to be impacting them. This species does not have life history traits whereby the ability to control key threatening processes is negligible.

3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.

The TBDC does not specifically indicate that data is unknown or deficient for this species.

4. In relation to the impacts from the proposal on the species at risk of an SAIL, the assessor must include data and information on:

a. The impact on the species' population (Principles 1 and 2) presented by:

- i. An estimate of the number of individuals (mature and immature) present in the subpopulation on the Development Footprint (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and
- ii. An estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or
- iii. If the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

b. Impact on geographic range (Principles 1 and 3) presented by:

Response to BAM Section 9.1.2 Criteria
<ul style="list-style-type: none"> i. The area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW ii. The impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted iii. To determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., Seed dispersal) and pollination distance for the species iv. To determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections.
<p>4ai. The species has not been recorded within the Development Footprint and no individuals are expected to occur within the Development Footprint. An assessment of assumed presence has been made for associated PCTs as the TBDC recommends surveys only within 5 years of a fire and these conditions have not been met for the associated PCTs within the Development Footprint. The extent of suitable habitat for the species within the Development Footprint is 0.36 ha.</p> <p>4aii. The species has not been recorded within the Project; no individuals are expected to occur within the Development Footprint.</p> <p>4aiii. The species is measured by area of habitat. One associated PCT exists within the Development Footprint, that is PCT 3388, Vegetation Condition Zone 5 - PCT 3388 VI Score = 51.8. The extent of suitable habitat present within the Development Footprint is 0.36 ha.</p> <p>4bi-iv. The AOO or EOO for this species is not known. The proposed works will impact a relatively small area of disturbed roadside habitats and are not expected to reduce the range of this species, fragment any subpopulations, change threats or environmental factors affecting subpopulations or reduce the viability of any subpopulations of this species.</p>
<p>5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAll, is inaccurate.</p>
<p>Not applicable.</p>

8.1.2.2 Regent Honeyeater (*Anthochaera phrygia*)

The additional impact assessment provisions for Regent Honeyeater (*Anthochaera phrygia*) are in **Table 8.3**. The location of the Regent Honeyeater species polygon within the Development Footprint is shown in **Figure 5.3**. This species is listed as critically endangered under the BC Act and the EPBC Act.

Table 8.3 SAIL Impact Assessment – Regent Honeyeater (*Anthochaera phrygia*)

Response to BAM Section 9.1.2 Criteria
<p>1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAIL, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAIL. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.</p> <p>Habitat clearing was reduced to the minimum necessary to construct and operate the access road. Thus, the proposal only requires minor clearing along an existing road edge. The total area of mapped important habitat to be cleared is 0.16 ha, with an additional 0.14 ha of Cleared Land also mapped. Most of this habitat is PCTs comprised of species considered to be key feed tree species, including White Box (<i>Eucalyptus albens</i>), Rough-barked apple (<i>Angophora floribunda</i>), Blakey’s Red Gum (<i>Eucalypts blakeyi</i>), and Yellow Box (<i>Eucalyptus melliodora</i>) (Crates 2023). Measures proposed to avoid indirect impacts on this species are documented in Section 7.0 of this report.</p>
<p>2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:</p> <p>a. Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:</p> <ul style="list-style-type: none"> i. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites <p>b. Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:</p> <ul style="list-style-type: none"> i. An estimate of the species’ current population size in NSW, and ii. An estimate of the decline in the species’ population size in NSW in three years or one generation (whichever is longer), and iii. Where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations <p>c. Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:</p> <ul style="list-style-type: none"> i. Extent of occurrence ii. Area of occupancy iii. Number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and iv. Whether the species’ population is likely to undergo extreme fluctuations <p>d. Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:</p> <ul style="list-style-type: none"> i. Known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., Species is clonal) on, a biodiversity stewardship site ii. The species is reliant on abiotic habitats which cannot be restored or replaced (e.g., Karst systems) on a biodiversity stewardship site, or iii. Life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., Frogs severely impacted by chytrid fungus).

Response to BAM Section 9.1.2 Criteria

The TBDC has been reviewed in relation to the information available for the Regent Honeyeater. Additional sources relied upon are referenced within the text below. The Regent Honeyeater is listed as an SAI under Principles 1 and 2.

a. The TBDC identifies that this species meets the criterion of a population reduction of >80% in 10 years or three generations.

The NSW Scientific Committee (2010) have estimated that generation length for the Regent Honeyeater is 5 years or 15 years for three generations.

The Regent Honeyeater Recovery Plan states that the Regent Honeyeater had prior to 2011 undergone a population decline of >80% within three generations (DoE 2016).

The NSW Scientific Committee's (2010) final determination to list the Regent Honeyeater as critically endangered estimated that there may have been fewer than 250 mature individuals left in the wild. The National Recovery Plan for this species estimates the population in 2010 at 350–400 mature individuals (DoE 2016). Crates (2023) estimated that there are currently fewer than 350 individuals persisting in the wild.

The population of the Regent Honeyeater declined significantly prior to the last 15 years and effective population monitoring is impeded by small population size and the species' nomadic behaviour coupled with a very large area of occupancy.

The 2019/20 mega fires that impacted the east coast of Australia represent a significant pulse impact event on the habitat quality of this species. Crates (2023) provided an estimate that the 2019/20 mega fires burnt an estimated 71,011 km² representing 13% of the species area of occupancy with high to very high burn severity identified for 54% of the burned area. Crates (2023) also identified that assessment based on Regent Honeyeater nest locations since 2015 returned the most severe fire impact estimate, with 44% of 1 km grid cells where nesting has been recorded, having been affected by fire.

The impact of the 2019/20 mega fire event is also likely to have exacerbated reduction in suitable foraging and breeding habitat from extensive land clearing and competition from larger, more aggressive honeyeater species such as the Noisy Miner.

b. The TBDC identifies that this species meets the criteria for a population size of <50 individuals or <250 individuals where threats are known.

Crates (2023) estimated that there are fewer than 350 individuals that persist in the wild.

Effective population monitoring is impeded by small population size and the species' nomadic behaviour coupled with a very large area of occupancy. Provision of an accurate estimation of the decline in the species' population size in NSW in one generation (5 years) is not possible based on current available data.

This species is not likely to undergo extreme fluctuations.

c. The Regent Honeyeater has a relatively large geographic range compared to its current population size. Crates (2023) estimate that the extent of occurrence for this species based on records from 1996 onwards is 605,690 km². BCD have estimated the extent of occurrence as 367,167 km². Crates (2023) estimates that the area of occupancy for this species based on records from 1996 onwards is 1,226 km². BCD have estimated the area of occupancy as 3,204 km².

BCD have identified that the Important Mapped Habitat Areas include nine (9) locations and of these four (4), are considered critical to the survival of the species: Bundarra-Barraba, Mudgee-Wollar, Capertee Valley and Hunter Valley. Within these mapped areas, breeding sites are likely to be critical to the species' survival. The Development Footprint, which entails minor clearing (0.16 ha) along an existing road edge within a buffer to a breeding location, is not critical to the species survival.

Based on available data it is considered that this species' population is not likely to undergo extreme fluctuations and the population trend reported in the scientific literature is of a continuing decline.

Response to BAM Section 9.1.2 Criteria

d. There is no data in the TBDC or the scientific literature suggesting that the species known reproductive characteristics severely limit its ability to increase existing population or occupy new habitat. However, this species is difficult to manage on a site-by-site basis due to its nomadic nature and the ability to increase the population on biodiversity stewardships sites is limited. Competition with Noisy Miners may only be mitigated with ongoing management intervention.

The species is not likely to be reliant on abiotic habitats which cannot be restored or replaced on a biodiversity stewardship site.

It is accepted that historical declines in the population of this species are attributable to extensive land clearing. Lack of breeding success is now considered to be one of the main reasons for the continuing population decline of the Regent Honeyeater due to threats such as competition from aggressive and larger honeyeaters and predation by natural predators. There is potential that these threats could be managed at a biodiversity stewardship site in limited circumstances, such as where nest sites are present and can be protected (Crates *et al.* 2018).

3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.

The TBDC does not specifically indicate that data is unknown or deficient for this species.

4. In relation to the impacts from the proposal on the species at risk of an SAll, the assessor must include data and information on:

a. The impact on the species' population (Principles 1 and 2) presented by:

- i. An estimate of the number of individuals (mature and immature) present in the subpopulation on the Development Footprint (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and
- ii. An estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or
- iii. If the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

b. Impact on geographic range (Principles 1 and 3) presented by:

- i. The area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW
- ii. The impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted
- iii. To determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., Seed dispersal) and pollination distance for the species
- iv. To determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections.

In relation to the impacts from the proposal on the species at risk of an SAll, the assessor must include data and information on:

Response to BAM Section 9.1.2 Criteria

a. The potential serious and irreversible impact trigger for this species is identified as removal of mapped important habitat, although other impacts may also result in a SAI on this species.

Areas identified in The National Recovery Plan (DoE 2016) as critical to the survival of the species formed the basis of the important habitat mapping in the BAM. These were refined to only include areas of suitable habitat based on expert opinion and PCTs associated with the species. A dataset of occurrence records was generated from BioNet, BirdLife Australia, Australian National University Difficult Bird Research Group and expert opinion of historic, unrecorded breeding.

Records were overlaid on the refined areas. All woodland vegetation within 200 m of a record was added. Records of known breeding events that occurred outside of the polygons created above were identified. Radial buffers of 1 km were applied to single breeding events (once off breeding at a location) and 5 km buffers applied to multiple breeding events (multiple events in the same year or over multiple years at one location). All woodland vegetation was selected within 1 km buffers. Within 5 km buffers, PCTs associated with the species were selected, along with all woodland vegetation within 200 m of a record.

The Development Footprint includes Goulburn River National Park, where multiple breeding events have been recorded both within the National Park and on adjoining lands (not within the Project Area). It is likely that the Development Footprint is within a 5 km buffer area of a breeding location.

No Regent Honeyeaters have been observed on the Development Footprint or in the adjacent solar farm footprint during surveys. However, this species is mobile and highly nomadic and may travel through or forage within the Development Footprint from time to time.

Six Regent Honeyeater pairs (12 mature individuals) nested within an area where Noisy Miners were culled within the Goulburn River National Park in 2017 (Crates 2023). It is estimated that approximately 12 individuals or less than 5% of the remaining population of Regent Honeyeaters may forage within or travelling through the Development Footprint at any one time. It is considered unlikely that this species would breed within the Development Footprint on the edges of the existing road. The species polygon for this species is mapped as 0.16 ha. The Project is not likely to have a measurable impact on the Regent Honeyeater. The road widening subject to this assessment is necessary to support the solar farm development and improve road safety for the local community. An expert report has been prepared as part of the Solar Farm BDAR, which identifies that the better available habitat for RHE within the Project Area is part of the proposed BSA.

b. The Project will impact a total of 0.16 ha of mapped important habitat for the proposed road upgrade works. Additional modification of cleared land, which is not likely to support this species as foraging or breeding habitat, may also occur. The Project will impact approximately 0.0001% of this species area of occupancy based on the area of occupancy estimated by Crates (2023) as 1,226 km² or 0.00005% of this species area of occupancy based on the BCD area of occupancy estimate of 3,204 km².

It is likely that the Project will affect a small amount (0.16 ha) of habitat for this species, but no individuals or known nesting locations of the species will be directly impacted and the Project will not fragment any subpopulation of the Regent Honeyeater as this species is highly mobile and nomadic.

The Project is unlikely to exacerbate impacts associated with habitat loss and competition from larger or more aggressive bird species such as the Noisy Miner (which favours disturbed landscapes and forest edge habitats) because only a small amount of clearing is required and this would occur along an existing road edge. Thus, no new habitat edge would be created. Management measures recommended for the associated solar farm development may include replanting, monitoring for Regent Honeyeaters and control of predators and/or over abundant competitors such as the Noisy Miner. These actions would benefit the individual Regent Honeyeaters that breeding within the national park.

5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAI, is inaccurate.

Not applicable.

8.1.2.3 Broad-headed Snake (*Hoplocephalus bungaroides*)

The additional impact assessment provisions for Broad-headed Snake (*Hoplocephalus bungaroides*) in **Table 8.4**. The location of the Broad-headed Snake species polygon within the Development Footprint is shown in **Figure 5.8**. This species is listed as endangered under the BC Act and the EPBC Act.

Table 8.4 SAII Impact Assessment – Broad-headed Snake (*Hoplocephalus bungaroides*)

Response to BAM Section 9.1.2 Criteria
<p>1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAII, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.</p> <p>Habitat clearing was reduced to the minimum necessary for road improvements. Thus, the Project only requires minor clearing along an existing road edge. The total area of Broad-headed Snake species polygon to be cleared is 1.05 ha within only one associated PCT (PCT 3781). Most of this area lacks rock crops and tree hollows required by this species. Measures proposed to avoid indirect impacts on this species are documented in Section 7.0 of this report.</p>
<p>2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:</p> <p>a. Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:</p> <ul style="list-style-type: none"> i. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites <p>b. Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:</p> <ul style="list-style-type: none"> i. An estimate of the species' current population size in NSW, and ii. An estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and iii. Where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations <p>c. Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:</p> <ul style="list-style-type: none"> i. Extent of occurrence ii. Area of occupancy iii. Number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and iv. Whether the species' population is likely to undergo extreme fluctuations <p>d. Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:</p> <ul style="list-style-type: none"> i. Known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., Species is clonal) on, a biodiversity stewardship site ii. The species is reliant on abiotic habitats which cannot be restored or replaced (e.g., Karst systems) on a biodiversity stewardship site, or

Response to BAM Section 9.1.2 Criteria
<p>iii. Life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., Frogs severely impacted by chytrid fungus).</p>
<p>The TBDC has been reviewed in relation to the information available for the Broad-headed Snake. Additional sources relied upon are referenced within the text below.</p> <p>a. The TBDC identifies that this species meets the criteria of a population reduction of >80% in 10 years or three generations.</p> <p>The Broad-headed Snake is a slow-growing species reaching sexual maturity at 5–6 years with a longevity of 28 years. A generation time of 10.4 years is estimated (DCCEEW 2023c).</p> <p>The entire distribution of the Broad-headed Snake occurs in NSW, separated into three distinct populations:</p> <ol style="list-style-type: none"> 1. Wollemi, Yengo and Capertee Uplands subregions including Wollemi, Yengo and Blue Mountains National Parks. 2. Sydney Cataract subregion from southern Sydney to the Wollongong hinterland. 3. Ettrema subregion in the Nowra hinterland. <p>Different population trends are evident in different sub-populations. The species appears to be stable in Royal National Park, however, it has declined by about 60% over 27 years (roughly three generations) between 1994 and 2020. Expert opinion predicts a further 8% decline (range 2–26%) in the three generations after the 2019/2020 fires assuming no further impacts.</p> <p>b. The TBDC identifies that this species meets the criteria for a population size of <50 individuals or <250 individuals where threats are known.</p> <p>The number of mature individuals is estimated to be 500–1000 (DCCEEW 2023c).</p> <p>The northern subpopulations (1 and 2) and the southern subpopulations (3) are evolutionary significant units, having diverged about 755,000 years ago (DCCEEW 2023c). The detection and abundance of the Broad-headed Snake varies across its range. The lowest detection rates are in the Yengo and Wollemi subregions in the north, which are approximately half those in Royal National Park in the Sydney Cataract subregion. Detection rates and densities are 5–30 times higher in the isolated Ettrema subregion (i.e. Morton National Park) than in Royal National Park.</p> <p>This species is not likely to undergo extreme fluctuations.</p> <p>c. The extent of occurrence is 17,725 km² with a maximum plausible value of <18,500 km² (DCCEEW 2023c). The Broad-headed Snake has a naturally patchy habitat and the Area of Occupancy is estimated to be 650–700 km². Historic sites where it was not detected in recent surveys were excluded. However, the species may also occur in additional areas that are remote and difficult to access. The maximum possible AOO is 1,000 km² (DCCEEW 2023c).</p> <p>d. The Broad-headed Snake is listed as an SAIL under Principle 4: species or ecological community that is unlikely to respond to management and is therefore irreplaceable.</p> <p>Threats to the Broad-headed Snake that are difficult to manage include bush rock removal and illegal collection. Other threats, such as fire management and vegetation overgrowth are somewhat under management control. However, the Broad-headed Snake are live-bearing with a low reproductive output. Clutches vary between 4 and 12 offspring and females only reproduce every 2-3 (but up to 4) years. Ambush predation in snakes is associated with low reproductive output. Thus, ambush predation is a strong predictor of a threatened status in this fauna group (Webb and Shine 1998).</p>
<p>3. Where the TBDC indicates data is ‘unknown’ or ‘data deficient’ for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.</p>
<p>The TBDC does not specifically indicate that data is unknown or deficient for this species.</p>

Response to BAM Section 9.1.2 Criteria

4. In relation to the impacts from the proposal on the species at risk of an SAll, the assessor must include data and information on:

a. The impact on the species' population (Principles 1 and 2) presented by:

- i. An estimate of the number of individuals (mature and immature) present in the subpopulation on the Development Footprint (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and
- ii. An estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or
- iii. If the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

b. Impact on geographic range (Principles 1 and 3) presented by:

- i. The area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW
- ii. The impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted
- iii. To determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., Seed dispersal) and pollination distance for the species
- iv. To determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections.

In relation to the impacts from the proposal on the species at risk of an SAll, the assessor must include data and information on:

a. The road footprint does not contain much area with rock outcrops and tree hollows are uncommon to rare.

Given the small area of the associated PCT 3781 within the development footprint (1.05 ha) and lack of important habitat features, it is possible that no Broad-headed Snakes occur in the clearing area. The maximum number of snakes is unlikely to exceed two. The total population of the Broad-headed Snake is estimated to be 500–1000 mature individuals (DCCEEW 2023c). Two snakes would, therefore, represent between 0.4% and 0.8% of the population.

b. The extent of occurrence is 17,725 km² with a maximum plausible value of <18,500 km² (DCCEEW 2023c).

The Broad-headed Snake has a naturally patchy habitat and the Area of Occupancy is estimated to be 650–700 km². Historic sites where it was not detected in recent surveys were excluded. However, the species may also occur in additional areas that are remote and difficult to access. The maximum possible AOO is 1,000 km² (DCCEEW 2023c).

The maximum clearing area arising from the proposed development would be 1.05 ha. This represents 0.00006% of the species' extent of occurrence and maximum of 0.0016% of its area of occupancy (based on 650 km²).

The proposed development is likely to affect up to 1.05 ha of potential Broad-headed Snake habitat. It is unlikely that any individuals would be directly impacted by the proposal due to the lack of rock outcrops in the development footprint and lack of any previous records for the Goulburn River National Park. Hollow-bearing trees are uncommon to rare along the clearing footprint. Supervised removal of any tree hollows will considerably reduce to potential for injury and mortality during clearing.

Response to BAM Section 9.1.2 Criteria
<p>The development proposal entails minor road widening. This is not likely to increase habitat fragmentation for the Broad-headed Snake, as the extent of clearing is minor (1.05 ha) and few critical habitat resources (a small number of hollow-bearing trees) would be removed. It is unlikely that the proposal would have a detectable effect on the viability of the local Broad-headed Snake population.</p> <p>The proposal entails minor road widening and a cumulative clearing footprint of 1.05 ha of potential habitat. Due to the minor impact, the proposal is not likely to alter environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites.</p>
<p>5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAIL, is inaccurate.</p>
<p>Not applicable.</p>

8.1.2.4 Large-eared Pied Bat (*Chalinolobus dwyeri*)

The additional impact assessment provisions for Large-eared Pied Bat (*Chalinolobus dwyeri*) in **Table 8.5**. The location of the Large-eared Pied Bat species polygons within the Development Footprint are shown in **Figure 4.4A** for foraging habitat and **Figure 4.4B** for breeding habitat. This species is listed as vulnerable under the BC Act and endangered under the EPBC Act.

Table 8.5 SAIL Impact Assessment – Large-eared Pied Bat (*Chalinolobus dwyeri*)

Response to BAM Section 9.1.2 Criteria
<p>1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAIL, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAIL. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.</p>
<p>Habitat clearing was reduced to the minimum necessary construct and operate the access road. Thus, the proposal only requires minor clearing along an existing road edge. The total area of potential foraging habitat to be cleared is 1.54 ha and 0.01 ha of potential breeding habitat. Specifically, no caves or other potential roosting and/or breeding structures would be directly impacted. Measures proposed to avoid indirect impacts on this species are documented in Section 7.0 of this report.</p>
<p>2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:</p> <p>a. Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:</p> <ul style="list-style-type: none"> i. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites <p>b. Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:</p> <ul style="list-style-type: none"> i. An estimate of the species' current population size in NSW, and ii. An estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and

Response to BAM Section 9.1.2 Criteria

- iii. Where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations

c. Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:

- i. Extent of occurrence
- ii. Area of occupancy
- iii. Number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and
- iv. Whether the species' population is likely to undergo extreme fluctuations

d. Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:

- i. Known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., Species is clonal) on, a biodiversity stewardship site
- ii. The species is reliant on abiotic habitats which cannot be restored or replaced (e.g., Karst systems) on a biodiversity stewardship site, or
- iii. Life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., Frogs severely impacted by chytrid fungus).

The TBDC has been reviewed in relation to the information available for the Large-eared Pied Bat. Additional sources relied upon are referenced within the text below.

- a. The Large-eared Pied Bat is a difficult species to study and little is known of its population size and ecology. The population size and trend are not known. The generation length to the Large-eared Pied Bat is not known. The species may reproduce during favourable years, but drought years may be missed. (DCCEEW 2023d).
- b. The Large-eared Pied Bat is a difficult species to study and little is known of its population size and ecology. The population size and trend are not known. The generation length to the Large-eared Pied Bat is not known. The species may reproduce during favourable years, but drought years may be missed. (DCCEEW 2023d).
- c. The species extent of occurrence is approximately 570,000 km². The area of occupancy is approximately 9,120 km² but is likely to be much smaller during the breeding season as only a few breeding sites have been identified (DERM 2011; DCCEEW 2023d).

Breeding habitat for this species is restricted to caves and escarpments. Few breeding sites have been identified. Accordingly, the loss or degradation of breeding sites would have a significant and possible catastrophic impact on the Large-eared Pied Bat.

The Large-eared Pied Bat is unlikely to undergo extreme fluctuations.

- d. The Large-eared Pied Bat is listed as an SAll under Principle 4: species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

The Large-eared Pied Bat gives birth to one or two young per year. Breeding may not occur during drought years. Thus, the species has a low reproductive output. Breeding habitat is also very limited. Due to the species breeding requirements (domed caves), there is low potential to find breeding sites to support this species.

The major threat to the Large-eared Pied Bat would be the loss of breeding habitat. Other threats, such as fire management and vegetation overgrowth are somewhat under management control. The Large-eared Pied Bat is listed as an SAll due to its reliance of specific caves for breeding.

3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.

The TBDC does not specifically indicate that data is unknown or deficient for this species.

Response to BAM Section 9.1.2 Criteria

4. In relation to the impacts from the proposal on the species at risk of an SAI, the assessor must include data and information on:

a. The impact on the species' population (Principles 1 and 2) presented by:

- i. An estimate of the number of individuals (mature and immature) present in the subpopulation on the Development Footprint (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and
- ii. An estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or
- iii. If the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

b. Impact on geographic range (Principles 1 and 3) presented by:

- i. The area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW
- ii. The impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted
- iii. To determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., Seed dispersal) and pollination distance for the species
- iv. To determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections.

In relation to the impacts from the proposal on the species at risk of an SAI, the assessor must include data and information on:

a. The road footprint does not contain much area with rock outcrops. Given the small area of the development footprint (1.54 ha of foraging habitat) and lack of important habitat features directly impacted, no breeding habitat for the Large-eared Pied Bat is present within the Development Footprint. However, if breeding did occur within 100 m, up to 40 individuals (the maximum reported size of a breeding colony: DCEEW 2023c) could potentially be indirectly impacted. through disturbance due noise and vibration during construction although any potentially impacted areas are already in close proximity to the existing road. This would be of a relatively short duration. Given the NSW population size is not known, it is not possible to determine what percentage of the population may be affected by the proposal.

Due to the small size of the clearing footprint and the lack of breeding structures directly impacted, it is unlikely that the proposal would have a detectable effect on the Large-eared Pied Bat population size or trend.

b. The species extent of occurrence is estimated at 570,000 km². The area of occupancy is estimated at 9,120 km² but is likely to be much smaller during the breeding season as only a few breeding sites have been identified (DERM 2011; DCCEEW 2023d). The percentage of these areas occurring in NSW has not been determined. The clearing footprint covers 1.54 ha of foraging habitat. This represents <0.0000027% of the extent of occurrence and 0.00017% of the area of occupancy.

Response to BAM Section 9.1.2 Criteria
<p>The Development Footprint does not contain any suitable breeding habitat for this species. Given the small area of the development footprint (1.54 ha) and lack of important habitat features directly impacted, it is likely that no Large-eared Pied Bats roost in the clearing area. However, if breeding did occur within the 100 m buffer for breeding habitat, up to 40 individuals (the maximum reported size of a breeding colony: DCEEW 2023c) could potentially be indirectly impacted by noise and vibration, particularly during construction however these areas are already near the existing road.</p> <p>The development proposal entails minor road widening. This is not likely to increase habitat fragmentation for the Large-eared Pied Bat, the extent of clearing is minor (1.54 ha) and it is unlikely that any critical habitat resources (i.e. breeding caves) would be removed. It is unlikely that the proposal would have a detectable effect on the viability of the local Large-eared Pied Bat population.</p> <p>The proposal entails minor road widening and a cumulative clearing footprint of 1.54 ha of potential habitat. Due to the minor scale and intensity of the likely impacts, the proposal is not likely to alter environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites.</p>
<p>5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAIL, is inaccurate.</p>
<p>Not applicable.</p>

8.1.2.5 Eastern Cave Bat (*Vespadelus troughtoni*)

The additional impact assessment provisions for Eastern Cave Bat (*Vespadelus troughtoni*) in Table 8.6. The location of the Eastern Cave Bat (*Vespadelus troughtoni*) species polygon within the Development Footprint is shown in **Figure 5.10A** for potential foraging habitat and **Figure 5.10D** for potential breeding habitat, noting that this species has been assessed via assumed presence. This species is listed as vulnerable under the BC Act.

Table 8.6 SAIL Impact Assessment – Eastern Cave Bat (*Vespadelus troughtoni*)

Response to BAM Section 9.1.2 Criteria
<p>1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAIL, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAIL. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.</p>
<p>Habitat clearing was reduced to the minimum necessary construct and operate the access road. Thus, the proposal only requires minor clearing along an existing road edge. The total area of relevant PCT to be cleared is 0.36 ha. Specifically, no caves or other potential roosting and/or breeding structures would be directly impacted. Measures proposed to avoid indirect impacts on this species are documented in Section 7.0 of this report.</p>
<p>2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:</p> <p>a. Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:</p> <p style="padding-left: 20px;">i. Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or</p>

Response to BAM Section 9.1.2 Criteria

- ii. **Decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites**

b. Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:

- i. **An estimate of the species' current population size in NSW, and**
- ii. **An estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and**
- iii. **Where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations**

c. Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:

- i. **Extent of occurrence**
- ii. **Area of occupancy**
- iii. **Number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and**
- iv. **Whether the species' population is likely to undergo extreme fluctuations**

d. Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:

- i. **Known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., Species is clonal) on, a biodiversity stewardship site**
- ii. **The species is reliant on abiotic habitats which cannot be restored or replaced (e.g., Karst systems) on a biodiversity stewardship site, or**
- iii. **Life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., Frogs severely impacted by chytrid fungus).**

The TBDC has been reviewed in relation to the information available for the Eastern Cave Bat. Additional sources relied upon are referenced within the text below.

a. Little is known about the life history and ecology of the Eastern Cave Bat. Its extent of occurrence includes the north-east sector of NSW, north from about the Hunter Valley and west to the Brigalow Belt South bioregion. Given its reliance caves for roosting and breeding it is likely that the area of occupancy is considerably smaller, particularly during the breeding season as breeding caves are likely to be more restricted in availability than roosting caves. The size of the total and NSW populations are not known. Therefore, a population trend cannot be determined.

b. As per response to (a).

c. As per response to (a).

The Eastern Cave Bat is unlikely to undergo extreme fluctuations.

d. Eastern Cave Bat is listed as an SAll under Principle 4: species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

The Eastern Cave Bat has a low reproductive output. Breeding habitat is also very limited due to the species' breeding requirements (domed caves). Accordingly, there is low potential to find breeding sites to support this species.

The major threat to the Eastern Cave Bat would be the loss of breeding habitat. Other threats, such as fire management and preventing the loss of foraging habitat particularly near maternity roosts, are somewhat under management control. The Eastern Cave Bat is listed as an SAll due to its reliance of specific caves for breeding.

Response to BAM Section 9.1.2 Criteria

3. Where the TBDC indicates data is ‘unknown’ or ‘data deficient’ for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.

The TBDC does not specifically indicate that data is unknown or deficient for this species.

4. In relation to the impacts from the proposal on the species at risk of an SAll, the assessor must include data and information on:

a. The impact on the species’ population (Principles 1 and 2) presented by:

- i. An estimate of the number of individuals (mature and immature) present in the subpopulation on the Development Footprint (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and**
- ii. An estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or**
- iii. If the species’ unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal**

b. Impact on geographic range (Principles 1 and 3) presented by:

- i. The area of the species’ geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW**
- ii. The impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted**
- iii. To determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., Seed dispersal) and pollination distance for the species**
- iv. To determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections.**

In relation to the impacts from the proposal on the species at risk of an SAll, the assessor must include data and information on:

a. The road footprint does not contain much area with rock outcrops. Given the small area of the development footprint (0.36 ha) and lack of important habitat features directly impacted, it is possible that no Eastern Cave Bats occur in the clearing area. However, if breeding did occur, up to 240 individuals (the maximum reported size of a breeding colony: Law et al. 2005) could potentially be impacted by the loss of foraging habitat. Given the minor clearing extent, and the expanse of higher quality foraging resources in the immediate surrounds, any impact on would expected to be minimal. Indirectly, a breeding colony may experience disturbance due noise and vibration during construction however areas within 100 m of the Development Footprint are already located close to the existing road. Potential impacts would be of a relatively short duration during construction. Given the NSW population size is not known, it is not possible to determine what percentage of the population may be affected by the proposal.

Due to the small size of the clearing footprint and the lack of breeding structures directly impacted, it is unlikely that the proposal would have a detectable effect on the Eastern Cave Bat population size or trend.

Response to BAM Section 9.1.2 Criteria

b. Estimates of the extent of occurrence and area of occupancy are not provided for the Eastern Cave Bat. Its total range north-east NSW to far North Queensland. Its extent of occurrence includes the north-east sector of NSW, north from about the Hunter Valley and west to the Brigalow Belt South bioregion. Given its reliance caves for roosting and breeding it is likely that the area of occupancy is considerably smaller, particularly during the breeding season as breeding caves are likely to be more restricted in availability than roosting caves. The size of the total and NSW populations are not known. Therefore, a population trend cannot be determined.

The proposed road widening entails minor vegetation removal along an existing road edge. The total loss of potential habitat is 0.36 ha. No roosting or breeding structures would be directly impacted. The proposed activities are not likely to directly impact on any individual Eastern Cave Bats.

The road footprint does not contain any rock outcrops. Given the small area of the development footprint (0.36 ha) and lack of important habitat features directly impacted, it is possible that no Eastern Cave Bats occur in the clearing area. However, if breeding did occur, up to 240 individuals (the maximum reported size of a breeding colony: Law et al. 2005) could potentially be indirectly impacted by noise and vibration, particularly during construction.

The development proposal entails minor road widening. This is not likely to increase habitat fragmentation for the Eastern Cave Bat, the extent of clearing is minor (0.36 ha) and it is unlikely that any critical habitat resources (i.e. breeding caves) would be removed. It is unlikely that the proposal would have a detectable effect on the viability of the local Eastern Cave Bat population.

The proposal entails minor road widening and a cumulative clearing footprint of 0.36 ha of potential habitat. Due to the minor scale and intensity of the likely impacts, the proposal is not likely to alter environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites.

5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAI, is inaccurate.

Not applicable.

9.0 Impact Summary

9.1 Determining an Offset Requirement for Impacts

9.1.1 Impacts on Native Vegetation and TECs (Ecosystem Credits)

Figure 9.1A-I shows impact areas requiring offsets, not requiring offsets and not requiring assessment. The PCTs and associated Vegetation Condition Zones which do not require an offset (as per BAM Subsection 9.2.1(3.)), are listed in **Table 9.1**.

Table 9.1 Impacts That Do Not Require Offset – Ecosystem Credits

Vegetation Condition Zone	PCT name	TEC	Impact area (ha)	TEC Association	Entity at risk of an SAIL?	Current VI score
Vegetation Condition Zone 2 Exotic Dominated Grassland (assessed against benchmarks for PCT 483)	Does not correspond to any PCTs however was assessed against benchmarks for Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley PCT	No	3.12	No	No	9.9

PCTs which require ecosystem credits are listed in **Table 9.2**.

Table 9.2 Impacts That Require an Offset – Ecosystem Credits

Vegetation Condition Zone	PCT name	TEC	Impact area (ha)	Current VI score	Future VI score	Change in VI score	Biodiversity risk weighting	Number of ecosystem credits required
PCT 483 Vegetation Condition Zone 1 Remnant Trees	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Yes	0.2	86.1	0	-86.1	2.5	11
PCT 1691 Vegetation Condition Zone 3 Remnant Trees	Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter	Yes	0.09	67.9	0	-67.9	2.5	4

Vegetation Condition Zone	PCT name	TEC	Impact area (ha)	Current VI score	Future VI score	Change in VI score	Biodiversity risk weighting	Number of ecosystem credits required
PCT 3334 Vegetation Condition Zone 4 Roadside Remnant Forest	Western Hunter Flats Red Gum Sedge Forest	No	0.04	62.1	0	-62.1	1.75	1
PCT 3388 Vegetation Condition Zone 5 Roadside Remnant Forest	Central West Valleys White Box Forest	Yes	0.36	51.8	0	-51.8	2.5	12
PCT 3781 Vegetation Condition Zone 6 Roadside Remnant Forest	Ulan Sandstone Ironbark-Pine Woodland	No	1.05	81.1	0	-81.1	1.5	32
Total Ecosystem Credits								60



- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Waterbodies
- Impact Areas**
- Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 9.1A
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



1:5,000
Scale at A4

0 0.25 0.5 Kilometres

GDA 1994 MGA Zone 56

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Waterbodies
- Impact Areas**
- Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 9.1B
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



1:5,000
Scale at A4

Legend

- Road
- Watercourse
- Property Boundaries
- Waterbodies
- Impact Areas**
- Impact Areas Requiring Offsets
- Impact Areas Not Requiring Assessment

FIGURE 9.1C

Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



1:5,000
Scale at A4

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Development Footprint
 - Waterbodies
- Impact Areas**
- Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Assessment

GDA 1994 MGA Zone 56

FIGURE 9.1D
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



1:5,000
Scale at A4

- Legend**
- Road
 - - - Property Boundaries
 - ▭ Development Footprint
 - Impact Areas**
 - Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 9.1E
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



1:5,000
Scale at A4

Legend

- Road
- Watercourse
- Property Boundaries
- Development Footprint
- Impact Areas**
- Impact Areas Requiring Offsets
- Impact Areas Not Requiring Offsets
- Impact Areas Not Requiring Assessment

GDA 1994 MGA Zone 56

FIGURE 9.1F
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)



1:5,000
Scale at A4

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Development Footprint
- Impact Areas**
- Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 9.1G

Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



1:5,000
Scale at A4

- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - Development Footprint
- Impact Areas**
- Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

GDA 1994 MGA Zone 56

FIGURE 9.1H
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment



- Legend**
- Road
 - Watercourse
 - Property Boundaries
 - ▭ Development Footprint
 - Waterbodies
- Impact Areas**
- Impact Areas Requiring Offsets
 - Impact Areas Not Requiring Offsets
 - Impact Areas Not Requiring Assessment

FIGURE 9.11
Impact Areas Requiring Offsets, Not Requiring Offsets and Not Requiring Assessment

9.1.2 Impacts on Threatened Species and Their Habitat (Species Credits)

Table 9.3 provides a summary of the species credit threatened species that require an offset (as per BAM Subsection 9.2.2(2)) and identifies the amount of credits required for each entity. Species polygons are mapped and presented in **Section 5.5**.

Table 9.3 Impacts that Require an Offset – Species Credits

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Loss of Habitat (ha)	Biodiversity Risk Weighting	Number of species credits required
<i>Commersonia rosea</i>	-	E	E	Zone 5 PCT 3388 = 0.36 Total = 0.36	3	Zone 5 PCT 3388 = 14 Total = 14
<i>Diuris tricolor</i>	Pine Donkey Orchid	V	-	Zone 3 PCT 1691 = 0.09 Total = 0.09	1.5	Zone 3 PCT 1691 = 2 Total = 2
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	Zone 3 PCT 1691 = 0.02 Zone 4 PCT 3334 = 0.01 Zone 5 PCT 3388 = 0.05 Zone 6 PCT 3781 = 0.08 Total = 0.16	3	Zone 3 PCT 1691 = 1 Zone 4 PCT 3334 = 1 Zone 5 PCT 3388 = 2 Zone 6 PCT 3781 = 5 Total = 9
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	E	Zone 3 PCT 1691 = 0.09 Zone 4 PCT 3334 = 0.04 Zone 5 PCT 3388 = 0.36 Zone 6 PCT 3781 = 1.05 Total = 1.54	3	Zone 3 PCT 1691 = 5 Zone 4 PCT 3334 = 2 Zone 5 PCT 3388 = 14 Zone 6 PCT 3781 = 64 Total = 85
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Zone 5 PCT 3388 = 0.29 ha Zone 6 PCT 3781 = 0.61 ha Total = 0.9	1.5	Zone 5 PCT 3388 = 6 Zone 6 PCT 3781 = 19 Total = 25
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V	-	Zone 3 PCT 1691 = 0.09 ha Total = 0.09	2	Zone 3 PCT 1691 = 3 Total = 3
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	E	Zone 6 PCT 3781 = 1.05 ha Total = 1.05	3	Zone 6 PCT 3781 = 64 Total = 64
<i>Ninox connivens</i>	Barking Owl	V	-	Zone 5 PCT 3388 = 0.02 ha	2	Zone 5 PCT 3388 = 1

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Loss of Habitat (ha)	Biodiversity Risk Weighting	Number of species credits required
				Zone 6 PCT 3781 = 0.29 ha Total = 0.31		Zone 6 PCT 3781 = 12 Total = 13
<i>Planigale maculata</i>	Common Planigale	V	-	Zone 3 PCT 1691 = 0.09 ha Total = 0.09	2	Zone 3 PCT 1691 = 3 Total = 3
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	Zone 5 PCT 3388 = 0.36 ha Total = 0.36	3	Zone 5 PCT 3388 = 14 Total = 14

9.1.3 Indirect and Prescribed Impacts

No offsets are required or proposed for indirect and prescribed impacts.

9.2 Impacts That Do Not Need Further Assessment

Areas within the Development Footprints that do not contain native vegetation do not need to be assessed for ecosystem credits (as per BAM Section 9.3(1–2.)). These areas are mapped as Cleared Land in **Figure 4.2** and consist of the existing road footprint and watercourse areas which do not contain native vegetation.

10.0 Matters of National Environmental Significance

10.1 Overview

As discussed in **Section 1.0** of this report, the Project requires approval under the EPBC Act.

On 2 February 2022, the Project was determined to be a Controlled Action requiring approval under the EPBC Act by the Commonwealth Minister for the Environment due to its potential impact on listed threatened species and ecological communities.

The assessment path for the Project is under the bilateral agreement between the Commonwealth and NSW Government. The Department of Climate Change, Energy the Environment and Water (DCCEEW) determined it a controlled action on 2 February 2022 and issued assessment requirements which were issued as Supplementary SEARs for the Project (refer to Appendix 1 of the EIS). A summary of the assessment findings related to MNES is included in Section 7.0 of the EIS and Part B of the Amendment Report.

The controlled action decision (EPBC 2021/ 9102) relates to the Solar Farm Project. The proponent is applying for a variation to the action to also include the road upgrades. This application is being done in parallel to the Amendment Report assessment, with timing determined in consultation with DPE and DCCEEW. The Road Upgrades BDAR includes the assessment of potential impacts to MNES associated with the road improvements.

This BDAR has been prepared in accordance with the BAM, to assess the biodiversity related impacts associated with the Project. The Commonwealth Assessment Requirements and where this BDAR addresses each requirement are summarised in **Table 1.1**. Relevant information and results obtained from site surveys specifically related to MNES are detailed within this section of the report.

10.2 NSW and Commonwealth Bilateral assessment

The Bilateral Agreement made under Section 45 of the EPBC Act relating to environmental assessment between the Commonwealth of Australia and NSW was signed by both parties in 2015. This Agreement enables NSW to conduct a single environmental assessment process. When the assessment process is complete, NSW provides a report to the Australian Government assessing the likely impacts on MNES listed under the EPBC Act.

An Amending Agreement between the Commonwealth and NSW was entered into on 24 March 2020, which endorses the NSW BAM (DPIE 2020a). Offsets are required under the EPBC Act for any residual significant adverse impacts on MNES. The Assessment Bilateral Agreement applies to all NSW projects that require EPBC Act approval to achieve streamlining benefits for projects that use the Biodiversity Offset Scheme (BOS).

10.3 Description of the Action

A detailed description of the of the road upgrade works can be found in **Section 1.2** of this BDAR and within Section 3.0 of the Amendment Report.

10.4 Site Context

An EPBC Act Protected Matters Report was generated using the Protected Matters Search Tool (PMST) (DCCEEW, 2023) on the 15 December 2023 to identify MNES that are known or have the potential to occur within 10 km of the Study Area. A copy of PMST is provided in **Appendix E**. The result of the PMST is summarised in **Table 10.1**. Relevant landscape features are show in **Figure 10.1**.

A detailed description of the landscape features associated with the Project can be found within **Section 3.0** of this report.

Table 10.1 Matters of National Environmental Significance

MNES	Relevance to Development
World Heritage Properties	None
National Heritage Properties	None
Wetlands of International Importance (Ramsar)	1 The Hunter estuary intersects with the 10 km buffer applied to the Subject Land. The Project is unlikely to impact the Hunter estuary wetlands as the Project is located approximately 100–150 km upstream.
Threatened Ecological Communities	7
Threatened Species	39
Migratory Species	10
State and Territory Reserves	1 (Goulburn River National Park)
Commonwealth Marine Area	None
Commonwealth Land	0
The Great Barrier Reef Marine Park	None

10.5 Threatened Ecological Communities

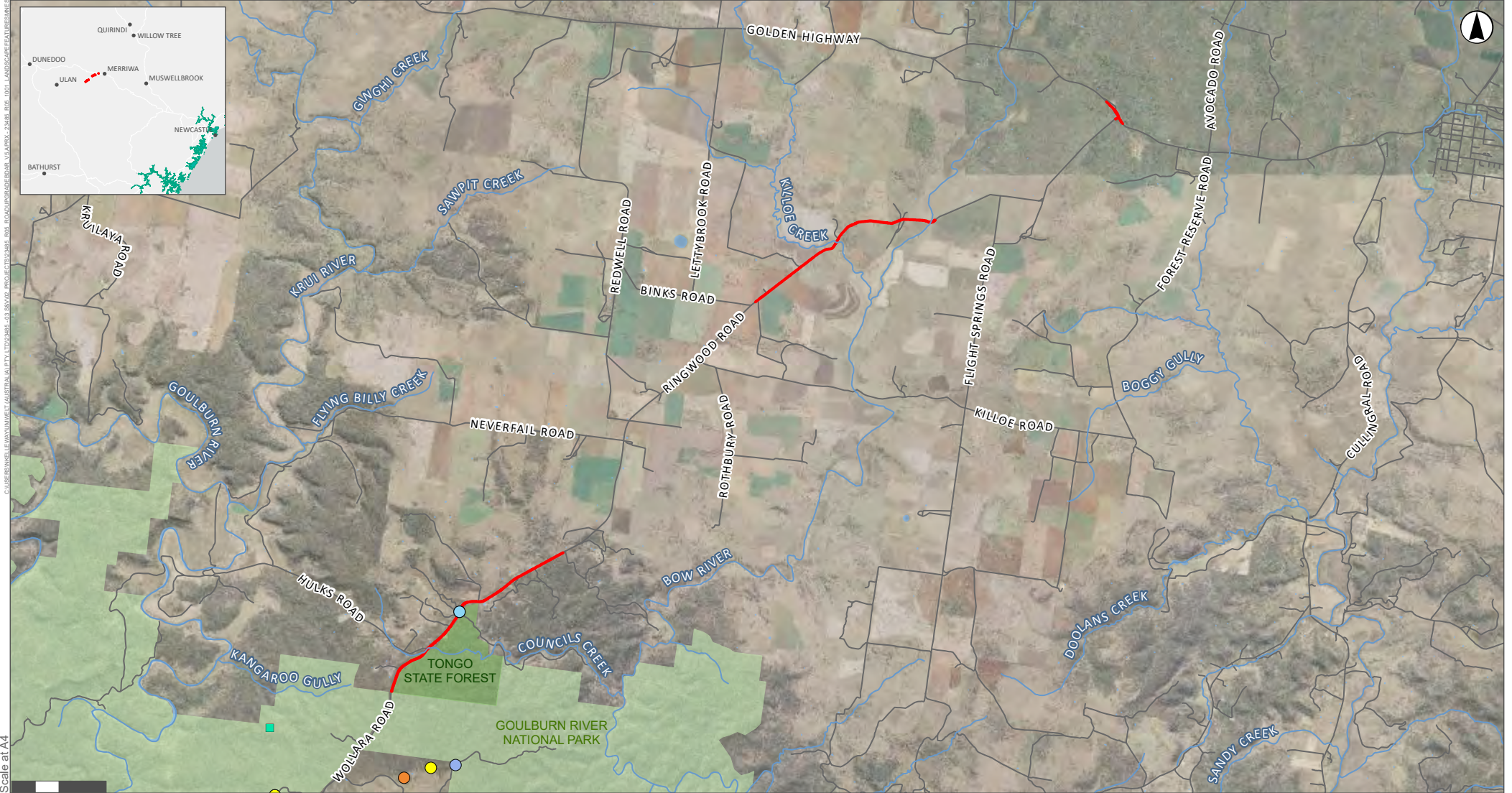
10.5.1 Literature and Databases Review

Seven TECs were identified in the Protected Matters Report as potentially occurring within the Development Footprint. Of these, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland was identified within the controlled action determination as an MNES which the Project would likely have a significant impact on.

A detailed description of the literature and database review carried out at part of the BDAR are provided in **Section 1.9** and **Section 2.2.1** of this report. **Table 10.2** summarises the Commonwealth guidelines and policy statements relating to White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland that that were reviewed as part of the literature and database review and where they have been considered within the assessment.

Table 10.2 Commonwealth guidelines and policies reviewed – White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland

MNES	BC Act	EPBC Act	Policy/guideline	Desktop review	Field survey and identification	Impact assessment	Avoidance and minimisation	Offsetting
White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland	CE	CE	Conservation Advice for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DCCEEW 2023a)	✓	✓	✓	✓	✓
			Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (TSSC 2006)	✓	✓	-	-	-
			National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DECCW 2010)	✓	✓	✓	✓	✓
			Threat abatement plan for disease in natural ecosystems caused by <i>Phytophthora cinnamomi</i> (DEE 2018)	✓	-	-	✓	-
			Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>) (DEE 2017)	✓	-	-	✓	-
			Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (DSEWPC 2011b)					
			EPBC Act policy statement 3.5 - White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands (DEH 2006a) Including associated supporting documents: <ul style="list-style-type: none"> Species list for the EPBC Act policy statement 3.5 - White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands - last updated 22 May 2006 (DEH 2006b). Advice on the presence of hybrids in listed ecological communities (TSSC 2011). 	✓	✓	✓	✓	✓



1:115,000
Scale at A4

0 1 2 Kilometres

Legend

- | | | |
|-----------------------|--|----------------------|
| Watercourse | Threatened Fauna Records (BioNet) | Diamond Firetail |
| Development Footprint | Endangered | Large-eared Pied Bat |
| Road | Malleefowl | Speckled Warbler |
| Estuary | South-eastern Hooded Robin | |
| Waterbodies | Vulnerable | |
| NSW State Forests | Brown Treecreeper (eastern subspecies) | |
| NSW National Parks | | |

GDA 1994 MGA Zone 56

FIGURE 10.1
Landscape Features – MNES

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

10.5.2 Vegetation Survey and Assessment

Surveys of the Development Footprint identified White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

A description of the vegetation surveys carried out in accordance with Section 4 of the BAM are detailed within **Section 4.0** of this BDAR. A summary of the BAM VI plot surveys carried out within the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland occurring within the Development Footprint is contained within **Table 10.3** below. The extent of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland within the Development Footprint is shown within **Figure 10.2A–C**.

Table 10.3 Threatened Ecological Communities listed under the EPBC Act present within the Development Footprint

Threatened Ecological Community	PCT	Vegetation Condition Zone	Area (ha) within Development Footprint	Plots required	Plots completed
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	PCT 483: Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Vegetation Condition Zone 1 – Remnant Trees	0.20	1 Plot	3 Plots: <ul style="list-style-type: none"> • Plot 2 • Plot 11 • Plot 12.
	PCT 1691: Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter	Vegetation Condition Zone 3 – Roadside Remnant Forest	0.09	1 Plot	1 Plot: <ul style="list-style-type: none"> • Plot 10.
	PC 3388: Central West Valleys White Box Forest	Condition Zone 5 – Remnant Forest	0.36	1 Plot	2 plots: <ul style="list-style-type: none"> • Plot 6 • Plot 7.



1:3,500
Scale at A4

0 Meters
Legend

- Watercourse
- Development Footprint
- Road
- Waterbodies
- NSW State Forests
- NSW National Parks
- Extent of EPBC Act listed White box – Yellow box – Blakey’s Red Gum Woodland

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

GDA 1994 MGA Zone 56

FIGURE 10.2A
White Box - Yellow Box - Blakey’s Red Gum
Grassy Woodland and Derived Native Grassland
within the Development Footprint Areas



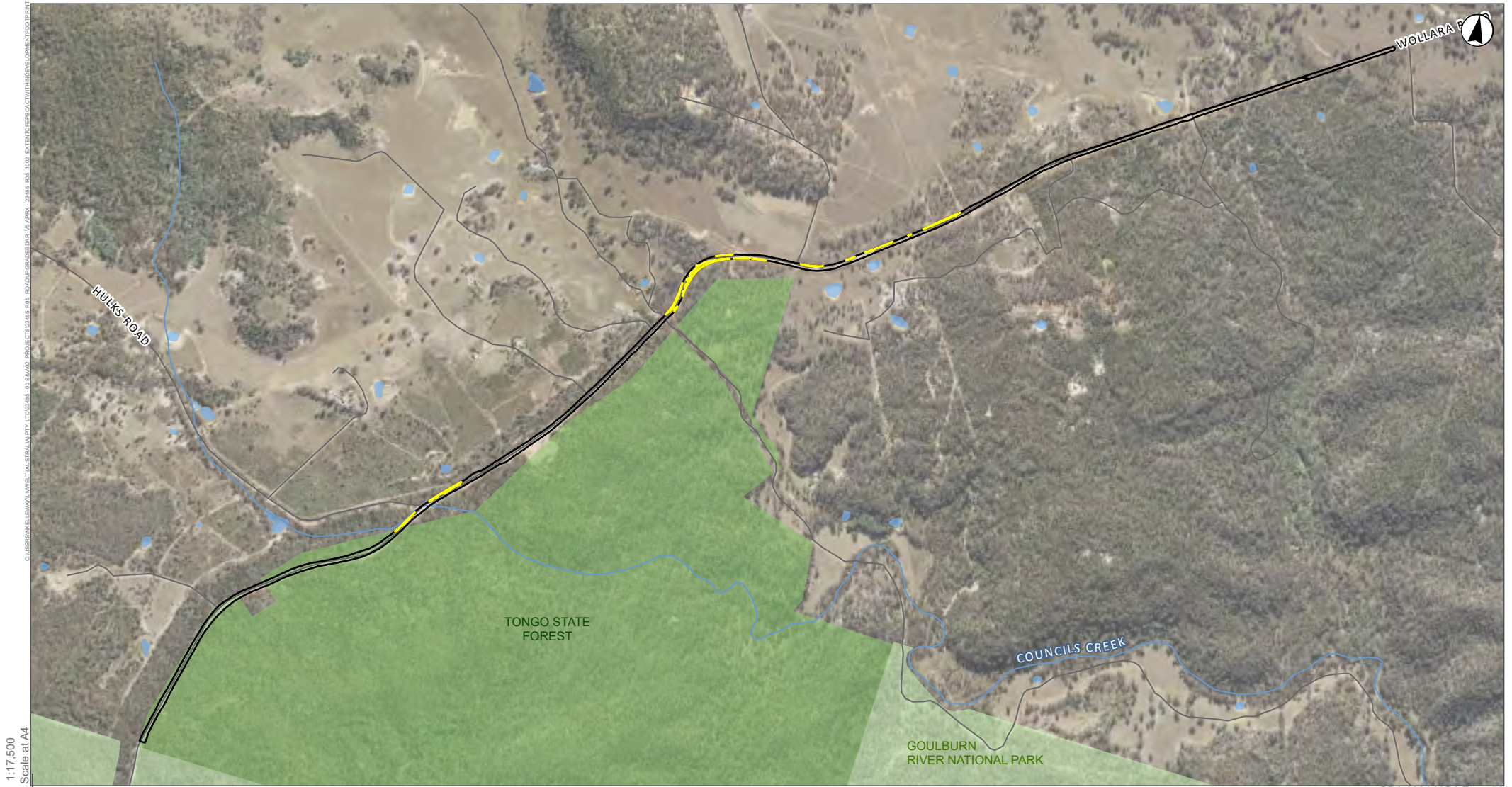
GDA 1994 MGA Zone 56

0 Meters
Legend

- Watercourse
- Development Footprint
- Road
- Waterbodies
- NSW State Forests
- NSW National Parks
- Extent of EPBC Act listed White box – Yellow box – Blakey’s Red Gum Woodland

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

FIGURE 10.2B
White Box - Yellow Box - Blakey’s Red Gum
Grassy Woodland and Derived Native Grassland
within the Development Footprint Areas



1:17,500
Scale at A4

- 0 Meters
- Legend**
- Watercourse
 - Development Footprint
 - Road
 - Waterbodies
 - NSW State Forests
 - NSW National Parks
 - Extent of EPBC Act listed White box – Yellow box – Blakey’s Red Gum Woodland

GDA 1994 MGA Zone 56

FIGURE 10.2C
White Box - Yellow Box - Blakey’s Red Gum Grassy Woodland and Derived Native Grassland within the Development Footprint Areas

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

10.6 Threatened Species

10.6.1 Threatened Flora

10.6.1.1 Literature and database review

Eleven threatened flora species were identified in the Protected Matters Report as potentially occurring within the Development Footprint. Of these, the following two species were identified within the controlled action determination as being potentially significantly impacted by the Project:

- Bluegrass (*Dichanthium setosum*)
- *Homoranthus darwinioides*.

A detailed description of the literature and database review carried out at part of the BDAR are provided in **Section 1.9** and **Section 2.3.1** of this report. **Table 10.4** summarises the Commonwealth guidelines and policy statements relating to the EPBC Act listed threatened flora species considered within this BDAR that were reviewed as part of the literature and database review, and where they have been considered within the assessment.

Table 10.4 Commonwealth Guidelines and Policies Reviewed – Threatened Flora

MNES	BC Act	EPBC Act	Policy/guideline	Desktop review	Field survey and identification	Impact assessment	Avoidance and minimisation
<i>Commersonia procumbens</i> (syn. <i>Androcalva procumbens</i> , <i>Rulingia procumbens</i>)	V	V	Approved Conservation Advice for <i>Rulingia procumbens</i> (DEWHA 2008a)	✓	✓	-	-
<i>Commersonia rosea</i> (syn. <i>Androcalva rosea</i>)	E	E	Approved Conservation Advice for <i>Commersonia rosea</i> (Sandy Hollow Commersonia) (DoE 2014a)	✓	✓	✓	✓
			Commonwealth Listing Advice on <i>Commersonia rosea</i> (TSSC 2008)	✓	✓	-	-
Bluegrass (<i>Dichanthium setosum</i>)	V	V	Approved Conservation Advice for <i>Dichanthium setosum</i> (DEWHA 2008b)	✓	✓	-	-
			Commonwealth Listing Advice on <i>Dichanthium setosum</i> (bluegrass) (TSSC 2012)	✓	✓	-	-
Fairy Bells (<i>Homoranthus darwinioides</i>)	V	V	Approved Conservation Advice for <i>Homoranthus darwinioides</i> (DEWHA 2008c)	✓	✓	-	-

MNES	BC Act	EPBC Act	Policy/guideline	Desktop review	Field survey and identification	Impact assessment	Avoidance and minimisation
<i>Ozothamnus tessellatus</i>	V	V	Approved Conservation Advice for <i>Ozothamnus tessellatus</i> (DEWHA 2008d)	✓	✓	-	-
Wollemi Mint-bush (<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>)	V	V	Approved Conservation Advice for <i>Prostanthera cryptandroides</i> (DEWHA 2008e)	✓	✓	-	-
<i>Prostanthera discolor</i>	V	V	Approved Conservation Advice for <i>Prostanthera discolor</i> (DEWHA 2008f)	✓	✓	-	-
<i>Tylophora linearis</i>	V	E	Approved Conservation Advice for <i>Tylophora linearis</i> (DEWHA 2008g)	✓	✓	-	-

10.6.1.2 Field Survey and Assessment

A detailed description of the field surveys and assessment of threatened flora listed under the EPBC Act can be found within **Section 2.3** and **Section 5.0** of this BDAR. Surveys were carried out with reference to the Commonwealth guidelines listed below:

- Draft survey guidelines for Australia's threatened orchids (Commonwealth of Australia, 2013).

Table 10.5 below summarises the field survey effort carried out for threatened flora listed under the EPBC Act.

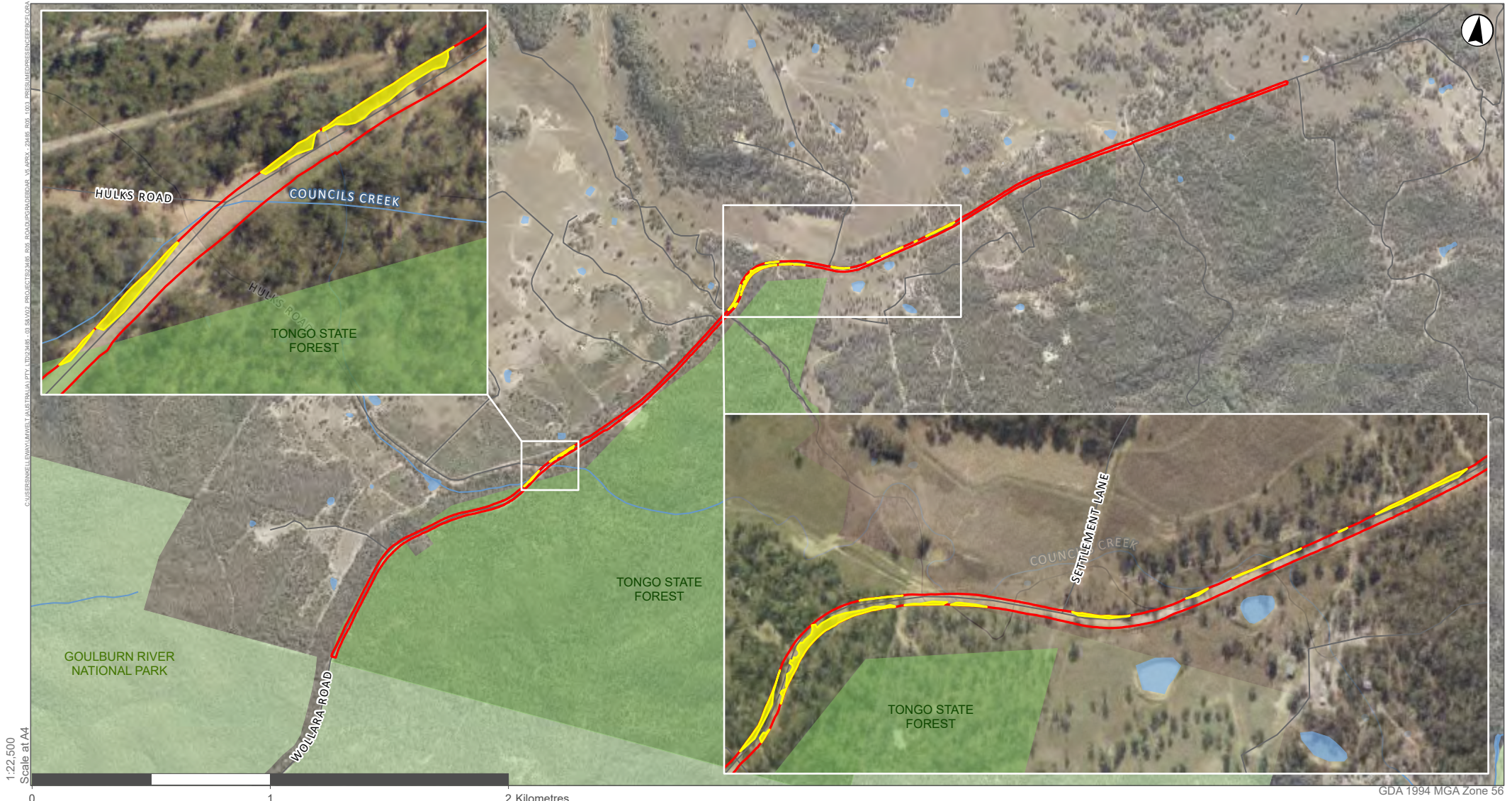
No threatened flora listed under the EPBC Act were recorded during surveys. However, due to survey timeframe limitations (i.e. lack of fire within the prior five years), *Commersonia rosea* (syn. *Androcalva rosea*) has been assumed present within the Development Footprint and considered further within the BDAR and this MNES assessment.

The areas within which the species has been assumed to be present are shown within **Figure 10.3**.

Table 10.5 Survey Methods and Effort for Threatened Flora Listed under the EPBC Act

Scientific Name	EPBC Act	Minimum Survey Requirements	Survey Method Utilised	Survey Date
<i>Commersonia rosea</i> (syn. <i>Androcalva rosea</i>)	E	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c).	Parallel field traverse at 5 m wide.	7–9 November 2023

Scientific Name	EPBC Act	Minimum Survey Requirements	Survey Method Utilised	Survey Date
Bluegrass (<i>Dichanthium setosum</i>)	V	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c).	Parallel field traverse at 5 m wide.	5 December 2023 (Bow River to Killoe Creek Section) 9 November 2023
Fairy Bells (<i>Homoranthus darwinioides</i>)	V	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c).	Parallel field traverse at 5 m wide.	7–11 August 2023 7–9 November 2023
<i>Ozothamnus tessellatus</i>	V	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c).	Parallel field traverse at 5 m wide.	7–9 November 2023 (surveyed outside of flowering season as can be detected without flowers)
Wollemi Mint-bush (<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>)	V	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c).	Parallel field traverse at 5 m wide.	7–9 November 2023
<i>Tylophora linearis</i>	E	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c).	Parallel traverse at 5 m width	7–9 November 2023



- Legend**
- Development Footprint
 - Road
 - Watercourse
 - Waterbodies
 - NSW State Forests
 - NSW National Parks
 - Areas of Assumed Presence for EPBC Act - Flora

FIGURE 10.3
Areas of Assumed Presence for EPBC Act Listed Threatened Flora Within the Development Footprint

10.6.2 Threatened Fauna

10.6.2.1 Literature and Database Review

Twenty-six threatened fauna species were identified in the Protected Matters Report as potentially occurring within the Development Footprint. Of these, the following five species were identified within the controlled action determination as being potentially significantly impacted by the Project:

- Swift Parrot (*Lathamus discolor*).
- Painted Honeyeater (*Grantiella picta*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Corben's Long-eared Bat (*Nyctophilus corbeni*).
- Pink tailed Worm-lizard (*Aprasia parapulchella*).

A detailed description of the literature and database review carried out at part of the BDAR are provided in **Section 1.9** and **Section 2.4.1** of this report. **Table 10.6** summarises the Commonwealth guidelines and policy statements relating to threatened fauna listed under the EPBC Act considered for further assessment within the BDAR that that were reviewed as part of the literature and database review, and where they have been considered within the assessment.

Table 10.6 Commonwealth Guidelines and Policies Reviewed – Threatened Fauna

MNES	BC Act	EPBC Act	Policy/guideline	Desktop review	Field survey and identification	Impact assessment	Avoidance and minimisation
Regent Honeyeater (<i>Anthochaera phrygia</i>)	CE	CE	Conservation Advice <i>Anthochaera phrygia</i> regent honeyeater (DoE 2015a)	✓	✓	✓	✓
			National Recovery Plan for the Regent Honeyeater (<i>Anthochaera phrygia</i>) (DoE 2016a)	✓	✓	✓	✓
			Threat abatement plan for competition and land degradation by rabbits (DoEE 2015b)	-	-	✓	✓
Pink-tailed Legless Lizard (<i>Aprasia parapulchella</i>)	V	V	Conservation Advice <i>Aprasia parapulchella</i> (TSSC 2015)	✓	✓	✓	✓
			Threat abatement plan for competition and land degradation by rabbits (DoEE 2016b)	-	-	✓	✓
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V	E	Conservation Advice for <i>Callocephalon fimbriatum</i> (Gang-gang Cockatoo) (DAWE 2022a)	✓	✓	✓	✓
Glossy Black-Cockatoo (<i>Calyptorhynchus lathami</i>)	V	V	Conservation Advice for <i>Calyptorhynchus lathami lathami</i> (South-eastern Glossy Black Cockatoo) (DAWE 2022b)	✓	✓	✓	✓
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	E	Conservation Advice for <i>Chalinolobus dwyeri</i> (large-eared pied bat) (DCCEEW 2023c)	✓	✓	✓	✓
			National recovery plan for the large-eared pied bat <i>Chalinolobus dwyeri</i> (DERM 2011)	✓	✓	✓	✓
Striped Legless Lizard (<i>Delma impar</i>)	V	V	Conservation Advice <i>Delma impar</i> striped legless lizard (TSSC 2016a)	✓	✓	✓	✓
			Threat abatement plan for predation by feral cats (DoE 2015b)	-	-	✓	✓
			Threat abatement plan for competition and land degradation by rabbits (DoEE 2016b)	-	-	✓	✓
			Threat abatement plan for predation by the European red fox (DEWHA 2008h)	-	-	✓	✓
			Referral guidelines for the striped legless lizard, <i>Delma impar</i> (DSEWPC 2011)	✓	✓	-	-

MNES	BC Act	EPBC Act	Policy/guideline	Desktop review	Field survey and identification	Impact assessment	Avoidance and minimisation
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	V	V	Approved Conservation Advice for <i>Heleioporus australiacus</i> (giant burrowing frog) (DoE 2014b)	✓	✓	✓	✓
			Threat abatement plan for predation by feral cats (DoE 2015b).	-	-	✓	✓
			Threat abatement plan for predation by the European red fox (DEWHA 2008h)	-	-	✓	✓
			Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoE 2016b)	-	-	✓	✓
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	E	E	Conservation Advice for <i>Hoplocephalus bungaroides</i> (broad-headed snake) (DCCEEW 2023)	✓	✓	✓	✓
			Threat abatement plan for predation by feral cats (DoE 2015b)	-	-	✓	✓
			Threat abatement plan for predation by the European red fox (DEWHA 2008h)	-	-	✓	✓
Swift Parrot (<i>Lathamus discolor</i>)	E	CE	Conservation Advice <i>Lathamus discolor</i> swift parrot (TSSC 2016b)	✓	✓	✓	✓
			National Recovery Plan for the Swift Parrot (<i>Lathamus discolor</i>) (Saunders & Tzaros 2011)	✓	✓	✓	✓
			Threat abatement plan for predation by feral cats (DoE 2015b)	-	-	✓	✓
Southern Greater Glider (<i>Petauroides volans</i>)	E	E	Conservation Advice for <i>Petauroides volans</i> (greater glider (southern and central)) (DCCEEW 2022)	✓	✓	✓	✓
			Guide to greater glider habitat in Queensland (Eyre <i>et al.</i> 2022)	✓	✓	✓	✓
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	E	V	Conservation Advice for <i>Petrogale penicillata</i> (Brush-tailed Rock-wallaby) (DAWE 2022c)	✓	✓	✓	✓
			National Recovery Plan for the Brush-tailed Rock-wallaby <i>Petrogale penicillate</i> (Menkhorst & Hynes 2010)	✓	✓	✓	✓

MNES	BC Act	EPBC Act	Policy/guideline	Desktop review	Field survey and identification	Impact assessment	Avoidance and minimisation
			Threat abatement plan for predation by feral cats (DoE 2015b)	-	-	✓	✓
			Threat abatement plan for predation by the European red fox (DEWHA 2008h)	-	-	✓	✓
			Threat abatement plan for competition and land degradation by rabbits (DoEE 2016b)	-	-	✓	✓
Koala (<i>Phascolarctos cinereus</i>)	E	E	Conservation Advice for <i>Phascolarctos cinereus</i> (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (DAWE 2022d)	✓	✓	✓	✓
			National Recovery Plan for the Koala <i>Phascolarctos cinereus</i> (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DAWE 2022e)	✓	✓	✓	✓
			Identifying habitat for the endangered Koala (DAWE 2022f)	✓	✓	✓	✓
			Referral guidance for the endangered koala (DAWE 2022g)	✓	✓	✓	✓
			Revegetating koala habitat (Beale <i>et al</i> 2022a)	✓	✓	✓	✓
			Effects of fire on koalas and their habitat (Beale <i>et al</i> 2022b)	✓	✓	✓	✓
			A review of koala habitat assessment criteria and methods (Youngentob et al. 2021)	✓	✓	✓	✓
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	Commonwealth Listing Advice on <i>Pteropus poliocephalus</i> (Grey-headed Flying-fox) (TSSC 2001)	✓	✓	✓	✓
			National Recovery Plan for the Grey-headed Flying-fox <i>Pteropus poliocephalus</i> (DAWE 2021b)	✓	✓	✓	✓
			Referral guideline for management actions in Grey-headed and Spectacled flying-fox camps (DoE 2015c)	✓	✓	✓	✓
			A review of noise, light and dust impacts on grey-headed flying-fox camps (Ecosure 2021)	✓	✓	✓	✓

10.6.2.2 Field Survey and Assessment

A detailed description of the field surveys and assessment of threatened flora listed under the EPBC Act can be found within **Section 2.3** and **Section 5.0** of this BDAR. Surveys were carried out with reference to the Commonwealth guidelines listed below:

- Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the EPBC Act, Department of Sustainability, Environment, Water, Population and Communities (DSEWPC 2011).
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act, Department of Sustainability, Environment, Water, Population and Communities (DEWHA 2010a).
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act, Department of Sustainability, Environment, Water, Population and Communities (DEWHA 2010b).
- Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DEWHA 2010c)

Table 10.7 below summarises the field survey effort carried out for threatened fauna listed under the EPBC Act.

The following EPBC Act listed threatened species were observed during surveys (observation details provided above in **Section 5.3.2**):

- Diamond firetail (*Stagonopleura guttata*).
- Brown Treecreeper (eastern subspecies) (*Climacterus picumnus victorie*).
- Hooded Robin (*Melanodryas cucullata*).

The listings events for each of the above species under the EPBC Act was only effective from 31 March 2023, which is after the decision on the referral for the Project and these species therefore do not require further consideration under the EPBC Act.

Furthermore, due to survey timeframe limitations, four fauna species listed under the EPBC Act have been assumed present within the Development Footprint and considered further within the BDAR and this MNES assessment:

- Regent Honeyeater (*Anthochaera phrygia*).
- Large-eared Pied-bat (*Chalinolobus dwyeri*).
- Giant Burrowing Frog (*Heleioporus australiacus*).
- Broad-headed Snake (*Hoplocephalus bungaroides*).

The areas within which the species has been assumed to be present are shown within **Figure 10.4**.

Table 10.7 Survey Methods and Effort for Threatened Fauna Listed under the EPBC Act

Scientific Name	EPBC Act	Minimum Survey Requirements	Survey Method Utilised	Survey Date
Regent Honeyeater (<i>Anthochaera phrygia</i>)	CE	For areas < 50 ha <ul style="list-style-type: none"> Area searches – 20 hours over 10 days Targeted searches – 20 hours over 5 days. 	N/A – Important habitat mapping adopted in accordance with Section 5.1.3 of the BAM.	N/A
Pink-tailed Legless Lizard (<i>Aprasia parapulchella</i>)	V	150–200 rocks rolled across areas of suitable habitat. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022).	200 rocks rolled x 4 replicates across all 3 Development Footprint (>2,400 rocks rolled).	31 October 2023 1–2 November 2023 8–10 November 2023 9 November 2023 17 November 2023
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	E	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DEC 2004).	Diurnal census on foot with watching and listening for signs of activity such as begging chicks around potential nesting trees and presence of adult birds.	1 November 2023 7–9 November 2023 16 November 2023
Glossy Black-Cockatoo (<i>Calyptorhynchus lathami</i>)	V	DCCEEW has not specified minimum survey requirements for this species. Surveys have been completed in accordance with relevant NSW guidelines (DEC 2004).	Diurnal census on foot through each of the Development Footprint and listening for begging chicks around potential nesting trees.	7–9 August 2023
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	E	Ecolocation – 30 to 60 mins of survey over 4 to 5 nights. Harp trapping – 32 trap nights over 2 to 3 nights.	Species assumed present due to survey timeframe constraints.	N/A
Striped Legless Lizard (<i>Delma impar</i>)	V	Rock rolling method detail: <ul style="list-style-type: none"> No minimum effort suggested, noted that success rate averages 1 positive observation per 150 rocks turned. Surveys have been completed in accordance with relevant NSW guidelines (DPE 2022c) for Pink-tail Worm-lizard.	200 rocks rolled x 4 replicates across all 3 Development Footprints (>2,400 rocks rolled).	31 October 2023 1–2 November 2023 8–10 November 2023 9 November 2023

Scientific Name	EPBC Act	Minimum Survey Requirements	Survey Method Utilised	Survey Date
		<p>Artificial cover method detail:</p> <ul style="list-style-type: none"> • Tiles installed at least three months prior to survey (i.e., before June). • September to December. • >30 ha, guideline suggests 10 tile grids. Each grid should be comprised of 10 x 5 tiles with 5 m spacing between tiles. For (i.e.,) a Development Footprint such as Goulburn River Solar Farm, this would equate to 500 tiles. • Tiles checked weekly for 8 weeks. 		17 November 2023
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	V	<p>Using spotlight surveys on foot and by road. Best results during and immediately after rainfall. Accompanied by habitat assessment by appropriately experienced personnel.</p> <p>Within one week of heavy rainfall (September–March) (heavy rainfall is >50 mm in seven days).</p>	Species assumed present due to survey timeframe constraints and lack of suitable weather conditions.	N/A
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	E	Active searches of appropriate sheltering sites with torches during winter.	Species assumed present due to survey timeframe constraints.	N/A
Swift Parrot (<i>Lathamus discolor</i>)	CE	<p>For areas < 50 ha</p> <p>Area searches – 20 hours over 8 days</p> <p>Targeted searches – 20 hours over 8 days</p> <p>Survey period March to July.</p>	N/A – Important habitat mapping adopted in accordance with Section 5.1.3 of the BAM.	N/A
Southern Greater Glider (<i>Petauroides volans</i>)	E	DCCEEW has not specified minimum survey requirements for this species.	Spotlighting mostly from a slow-moving vehicle (<5 km/hr) due to the roadside nature of the Development Footprint, with some spotlight searches also completed on foot.	<p>9 August 2023</p> <p>10 August 2023</p> <p>7 November 2023</p>

Scientific Name	EPBC Act	Minimum Survey Requirements	Survey Method Utilised	Survey Date
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	V	Daytime searches for potentially suitable habitat resources, such as shelters sites and signs of activity, such as scats or tracks. Baited cameras for 14 nights.	Active diurnal surveys for scats and occupied habitat. 2 x baited remote sensor cameras approximately 0.5 m above the ground, 30 trap nights carried out.	1–16 November 2023
Koala (<i>Phascolarctos cinereus</i>)	E	DCCEEW has not specified minimum survey requirements for this species but suggest the following methods: <ul style="list-style-type: none"> • KSAT surveys. • Spotlighting. • Acoustic detection. • Dog surveys. 	38 SAT surveys Spotlighting from slow moving vehicle and on foot.	9 August 2023 10 August 2023 7 November 2023
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	DCCEEW has not specified minimum survey requirements for this species but suggest the following methods: <ul style="list-style-type: none"> • Day time searches for camps. • Vegetation surveys to plant and food resources. Nocturnal transects at 100 m width looking for foraging and flying individuals.	Initial searches were undertaken for camp sites and a check of the National Flying-fox Monitoring Viewer was undertaken.	August 2023



1:20,000
Scale at A4

- Legend**
- Development Footprint
 - Road
 - Watercourse
 - Waterbodies
 - NSW State Forests
 - NSW National Parks
 - Areas of Assumed Presence for EPBC Act - Fauna

Image Source: ESRI Basemap (2023) Data source: NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023)

FIGURE 10.4
Areas of Assumed Presence for EPBC Act Listed
Threatened Fauna Within the Development Footprint

10.7 Migratory Species

Eighteen migratory species were identified in the PMST, of these four were known of likely to occur within the Study Area:

- Fork-tailed Swift (*Apus pacificus*).
- White-throated Needletail (*Hirundapus caudacutus*).
- Satin Flycatcher (*Myiagra cyanoleuca*).
- Rufus Fantail (*Rhipidura rufifrons*).

The Development Footprint consists of limited remnant scattered canopy trees which are connected and are often adjacent to degraded agricultural land. There is limited suitable habitat for any migratory species within the Assessment Area as such it is considered low or unlikely that any of these migratory species would occur.

No EPBC Act listed migratory birds were observed during surveys, no further survey or assessment has been conducted.

10.8 Avoidance and Mitigation

All works across the Development Footprint will be contained within the road reserves and adjacent roadside areas, with the exception of the intersection upgrade works which will require minor encroachment into private property. The Project design has been refined to avoid impacts to biodiversity, as such the patch of EPBC-listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been avoided and will be retained within the wider Project Area.

Areas impacted by the proposed works are considered to have low biodiversity values, further retention of individual trees will be considered in the detailed design phase.

A detailed breakdown of the measures taken to avoid and minimise impacts to MNES are provided in **Section 6.0** above.

10.9 Impacts

One CEEC, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, was found to be present within the Development Footprint. While avoidance and minimisation measures have reduced the scale of the impact, 0.61 ha of the CEEC would be removed as part of project works.

The project would also impact five threatened flora and fauna species listed under the EPBC Act assumed to be present within the Development Footprint, including:

- *Commersonia rosea* (Syn. *Androcalva rosea*).
- Regent Honeyeater (*Anthochaera phrygia*).
- Large-eared Pied-bat (*Chalinolobus dwyeri*).

- Giant Burrowing Frog (*Heleioporus australiacus*).
- Broad-headed Snake (*Hoplocephalus bungaroides*).

Whilst three bird species listed under the EPBC Act were recorded during the field surveys (as detailed within **Section 10.6.2.2**), these species were listed subsequent to Project's referral decision and therefore do not require further consideration under the EPBC Act.

A summary of impacts to MNES as a result of the public road and culvert works is provided within **Table 10.8** below. A detailed assessment of the impacts associated with the project can be found within **Section 7.0** and **Section 8.0** of this BDAR.

Table 10.8 Impact to EPBC Act Species and Communities

Name of EPBC Act listed entity	Nature & consequence of impact (direct and indirect)	Duration of impact (e.g. construction, operation, life of the Project)	Quantum of impact (ha)	Consequence of impact (local, state & national scales)	Impact requires offsetting? (significant or not)
White Box -Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Direct and indirect	Construction. There is the potential for indirect impacts such as edge effects and weed invasion to be ongoing at low levels through the operation of the Project	0.61	Local	Impacts will be offset
<i>Commersonia rosea</i>	Direct and indirect	Construction	0.36*	Local	Impacts will be offset
Regent Honeyeater (<i>Anthochaera phrygia</i>)	Direct and indirect	Construction	0.16^	Local	Impacts will be offset
Large-eared Pied-bat (<i>Chalinolobus dwyeri</i>)	Direct and indirect	Construction	1.54*	Local	Impacts will be offset
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	Direct and indirect	Construction	0.9*	Local	Impacts will be offset
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	Direct and indirect	Construction	1.05*	Local	Impacts will be offset

* = Assessed via assumed presence, ^ = Assessed via mapped important habitat.

10.10 Offsets

The public road and culvert upgrade component of the Project has avoided impacts that would result in offsets for the MNES recorded or assumed present within the Development Footprint. Impacts associated with these impacts have been assessed via the BAM, with each entity generating an offset credit liability as calculated within the BAMC.

There are no significant impacts to MNES which are not proposing to be offset via the BAM.

A detailed description of the biodiversity offset liability for the Project generated by the BAMC is provided within **Section 11.0** of this report. **Table 10.9** below summarises the offset liabilities for all MNES impacted by the proposed work.

Table 10.9 Offset Liabilities for MNES Entities Impacted by the Project

Threatened Species / Community listed under EPBC Act	PCTs associated with the species / ecological community (if applicable)	Area of impacts (ha)	Credits required	Offsetting approach
White Box -Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	PCT 483 Vegetation Condition Zone 1 Remnant Trees (in part)	0.16	11	Like for like
	PCT 1691 Vegetation Condition Zone 3 Remnant Trees	0.09	4	
	PCT 3388 Vegetation Condition Zone 5 Roadside Remnant Forest	0.36	12	
	Total	0.61	27	
<i>Commersonia rosea</i>	PCT 3388 Zone 5 Remnant Forest	0.36	14	Like for like
Regent Honeyeater (<i>Anthochaera phrygia</i>)	PCT 1691 Condition Zone 3 Remnant Forest	0.02	1	Like for like
	PCT 3334 Condition Zone 4 Remnant Forest	0.01	1	
	PCT 3388 Condition Zone 5 Remnant Forest	0.05	2	
	PCT 3781 Condition Zone 6 Remnant Forest	0.08	5	
	Total	0.16	9	
Large-eared Pied-bat (<i>Chalinolobus dwyeri</i>)	PCT 1691 Condition Zone 3 Remnant Forest	0.09	5	Like for like
	PCT 3334 Condition Zone 4 Remnant Forest	0.04	2	
	PCT 3388 Condition Zone 5 Remnant Forest	0.36	14	
	PCT 3781 Condition Zone 6 Remnant Forest	1.05	64	
	Total	1.54	85	
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	PCT 3388 Condition Zone 5 Remnant Forest	0.29	6	Like for like
	PCT 3781 Condition Zone 6 Remnant Forest	0.61	19	
	Total	0.09	25	
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	PCT 3781 Condition Zone 6 Remnant Forest	1.05	64	Like for like

11.0 Offsets

The impacts of the Project related to the proposed road and culvert upgrade works will be offset in accordance with the BAM as outlined below.

There are no additional significant residual impacts to MNES not addressed by the BAM.

11.1 Biodiversity Credit Obligations

Biodiversity Credit Reports which identify the like-for-like and variation credit requirements are provided in **Appendix F**. Further details on the biodiversity credit requirements for the project are provided as follows.

11.2 Ecosystem Credits

The ecosystem credit requirements and those that could be retired in accordance with the like for like offset rules are listed in **Table 11.1**.

Table 11.1 Ecosystem Credit Like for Like Requirements

Ecosystem Credit	Attributes shared with matching credits						
	PCT Name	PCT Vegetation Class	PCT Vegetation Formation	Associated TEC	Offset Trading Group	Hollow bearing trees present?	IBRA subregion (in which proposal is located)
PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley 11 credits	74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 847, 851, 921, 1099, 1303, 1304, 1307, 1324, 1329, 1330, 1332, 1383, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150	Grassy Woodlands	Western Slopes Grassy Woodlands	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC	Yes	Liverpool Range, Hunter, Kerrabee, Liverpool Plains, Peel and Pilliga. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
PCT 1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter 4 Credits	74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567,	Grassy Woodlands	Coastal Valley Grassy Woodlands	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC	Yes	Liverpool Range, Hunter, Kerrabee, Liverpool Plains, Peel and Pilliga. or Any IBRA subregion that is within 100 km

Ecosystem Credit	Attributes shared with matching credits						
	PCT Name	PCT Vegetation Class	PCT Vegetation Formation	Associated TEC	Offset Trading Group	Hollow bearing trees present?	IBRA subregion (in which proposal is located)
	571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 847, 851, 921, 1099, 1303, 1304, 1307, 1324, 1329, 1330, 1332, 1383, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150						of the outer edge of the impacted site.
3334-Western Hunter Flats Red Gum Sedge Forest 1 credit	Coastal Valley Grassy Woodlands This includes PCT's: 618, 622, 623, 1603, 1604, 1691, 1692, 3269, 3312, 3314, 3315, 3316, 3318, 3319, 3320, 3323, 3325, 3327, 3328, 3329, 3330, 3332, 3334, 4052	Coastal Valley Grassy Woodlands	Grassy Woodlands	-	Coastal Valley Grassy Woodlands - ≥ 50% - < 70% cleared group (including Tier 3 or higher threat status).	No	Kerrabee, Hunter, Inland Slopes, Liverpool Range, Pilliga, Wollemi and Yengo. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
3388-Central West Valleys White Box Forest 2 credits	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow	Western Slopes Grassy Woodlands	Grassy Woodlands	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and	No	Kerrabee, Hunter, Inland Slopes, Liverpool Range, Pilliga, Wollemi and Yengo. or

Ecosystem Credit	Attributes shared with matching credits						
	PCT Name	PCT Vegetation Class	PCT Vegetation Formation	Associated TEC	Offset Trading Group	Hollow bearing trees present?	IBRA subregion (in which proposal is located)
	Belt South, Sydney Basin, South Eastern Highlands This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 847, 851, 921, 1099, 1303, 1304, 1307, 1324, 1329, 1330, 1332, 1383, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150			Derived Native Grassland	Derived Native Grassland TEC		Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
3781-Ulan Sandstone Ironbark-Pine Woodland 5 credits	Western Slopes Dry Sclerophyll Forests This includes PCT's: 54, 110, 179, 217, 243, 255, 270, 273, 287, 291, 309, 321, 322, 323, 324, 325, 327, 330, 331, 333, 341, 343, 346, 348, 354, 358, 379, 387, 396,	Dry Sclerophyll Forests (Shrubby	Western Slopes Dry Sclerophyll Forests	-	Western Slopes Dry Sclerophyll Forests - < 50% cleared group (including Tier 4	Yes	Kerrabee, Hunter, Inland Slopes, Liverpool Range, Pilliga, Wollemi and Yengo. or

Ecosystem Credit	Attributes shared with matching credits						
	PCT Name	PCT Vegetation Class	PCT Vegetation Formation	Associated TEC	Offset Trading Group	Hollow bearing trees present?	IBRA subregion (in which proposal is located)
	398, 399, 401, 402, 403, 404, 405, 406, 407, 408, 409, 414, 415, 417, 419, 420, 423, 425, 430, 431, 440, 443, 449, 455, 456, 457, 459, 462, 463, 467, 468, 469, 470, 471, 472, 473, 476, 477, 478, 479, 480, 482, 515, 531, 532, 576, 577, 581, 592, 610, 617, 671, 673, 676, 712, 713, 714, 746, 863, 889, 940, 956, 1133, 1176, 1277, 1278, 1279, 1307, 1313, 1314, 1316, 1381, 1610, 1654, 1655, 1656, 1660, 1661, 1663, 1668, 1669, 1671, 1672, 1674, 1676, 1679, 1709, 1711, 1770, 1771, 3753, 3754, 3756, 3757, 3758, 3759, 3760, 3761, 3762, 3763, 3766, 3767, 3768, 3769, 3770, 3771, 3772, 3773, 3774, 3775, 3776, 3777, 3778, 3780, 3781, 3782, 3783, 3784, 3785, 3786, 4153	sub-formation)			or higher threat status).		Any IBRA subregion that is within 100 km of the outer edge of the impacted site.

11.3 Species Credits

The species credit requirements and those that could be retired in accordance with the like for like offset rules are listed in **Table 11.2**. Further details on the like for like and variation credit requirements are provided in the Credit Reports provided in **Appendix F**.

Table 11.2 Species Credit Like for Like Requirements and Eligibility for Variation Rules

Species Credit	Eligible for variation rules	Kingdom	BC Act Status	EPBC Act Status	IBRA Subregion
<i>Commersonia rosea</i>	No	Flora	E	E	Any in NSW
Pine Donkey Orchid <i>Diuris tricolor</i>	Yes	Flora	V	-	Any in NSW
Regent Honeyeater <i>Anthochaera phrygia</i>	No	Fauna	CE	CE	Any in NSW
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	No	Fauna	V	E	Any in NSW
Giant Burrowing Frog <i>Heleioporus australiacus</i>	No	Fauna	V	E	Any in NSW
Pale-headed Snake <i>Hoplocephalus bitorquatus</i>	Yes	Fauna	V	-	Any in NSW
Broad-headed Snake <i>Hoplocephalus bungaroides</i>	Not applicable for EPBC Act listed species	Fauna	E	E	Any in NSW
Barking Owl <i>Ninox connivens</i>	Yes	Fauna	V	-	Any in NSW
Common Planigale <i>Planigale maculata</i>	Yes	Fauna	V	-	Any in NSW
Eastern Cave Bat <i>Vespadelus troughtoni</i>	Yes	Fauna	V	-	Any in NSW

11.4 Biodiversity Credit Retirement

Lightsource bp is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project.

Lightsource bp has, where practicable, altered the Project to avoid and minimise ecological impacts in the planning stage, and a range of impact mitigation strategies have been included to mitigate the impact on ecological values prior to the consideration of offsetting requirements.

The retirement of biodiversity credits is proposed to be undertaken following a staged approach, to match the areas of staged clearing. Lightsource bp is currently considering the merits of all options available under the BOS to satisfy the offsetting requirements for the Project. The offset options available under the BC Act and BC Regulation include:

- land based offsets through the establishment of new Stewardship Sites or by retiring credits from existing Stewardship Sites
- purchasing credits from the market; and/or
- paying into the Biodiversity Conservation Fund.

The offset strategy has also taken into account the presence of the critically endangered ecological community White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland and will achieve the like for like offsetting requirements for all EPBC Act listed entities.

The biodiversity offset strategy consists of the following:

- Establishment of an approximately 1,200 ha Biodiversity Stewardship Agreement (BSA) over the residual parts of the Project Area.
- Retirement of residual credits across two existing BSAs.
- Payment into the BCF.

Further details of the BSA which is proposed to be established in the residual parts of the Goulburn River Solar Farm Project Area are provided in the Solar Farm BDAR prepared by Umwelt (2024).

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