



Biodiversity Development Assessment Report (BDAR)

Mamre Road Upgrade – Stage 1

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Executive summary

Project outline

Transport for NSW (TfNSW) proposes to upgrade about 3.8 kilometres of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park to a four-lane divided road (the proposal). The proposal is located in the Penrith City Local Government Area (LGA), New South Wales (NSW). The proposal forms Stage 1 of the proposed broader Mamre Road Upgrade project.

Mamre Road is a key transport corridor, which provides connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis. A key aim of the proposal is to improve road safety and movement between the M4 Motorway and Erskine Park Road through increasing the capacity of Mamre Road, which would support future economic and residential growth in the surrounding area.

The proposal would involve widening Mamre Road from one lane either direction to two lanes in each direction. The proposal includes changes and upgrades to existing intersections and new facilities for public transport, walking and cycling along Mamre Road. Sufficient space within the road corridor would also be provided for an additional lane in each direction if required in the future.

Niche Environment and Heritage Pty Ltd (Niche) has been commissioned to prepare a Biodiversity Development Assessment Report (BDAR) to support the Review of Environmental Factors (REF) for the proposal.

This BDAR complies with the Biodiversity Assessment Methodology (BAM) (DPIE 2020a) to adequately assesses potential impacts to threatened biodiversity listed on the NSW *Biodiversity Conservation Act 2016* (BC Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Methodology

Field survey was completed across multiple months in accordance with the BAM and relevant threatened biodiversity survey guidelines.

Surveys completed included:

- Floristic and BAM plots to determine Plant Community Type (PCT) and condition
- Hollow-bearing tree targeted survey
- Cumberland Plain Land Snail and Dural Snail targeted searches
- Spotlighting
- Anabat analysis
- Opportunistic and fauna habitat observations
- Searches for threatened plants.

Results

The field survey confirmed that about 9.38 hectares of native vegetation and associated habitat, and 35.46 hectares of non-native vegetation (comprising of existing Mamre Road, services, footpaths, cleared areas) occurs within the vegetation clearing boundary. The native vegetation has been subjected to historical clearing, edge effects from the existing Mamre Road and surrounding residential/rural land.

The native vegetation comprises the following Plant Community Types (PCTs):

- PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

The PCTs are also listed as the following Threatened Ecological Communities (TECs) under both State and Commonwealth Legislation:

- PCT 849 aligns to Cumberland Plain Woodland which is listed as Critically Endangered Ecological Community (CEEC) under the BC Act and the EPBC Act.
- PCT 835 aligns to River-flat Eucalypt Forest which is listed as a CEEC under the BC Act and Endangered Ecological Community (EEC) under the EPBC Act.
- PCT 1800 aligns to Swamp Oak Floodplain Forest, listed as an EEC under the BC Act and EPBC Act.

No threatened flora species were identified during the field investigations in the vegetation clearance boundary.

Seven threatened fauna species were recorded during the field survey, including Cumberland Plain Land Snail, Grey-headed Flying-fox, Southern Myotis, Large Bentwing-bat, Little Bentwing-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat.

Potential impacts

The proposal would result in the direct impact to about 9.38 ha of vegetation regarded as 'native vegetation,' as defined in the BAM. The majority of vegetation likely to be affected by the proposal is located adjacent to Mamre Road, and has been subject to historic clearing, grazing, and other agricultural activities, and is therefore thinned in areas, and dominated in areas by a range of introduced species.

The proposal would have a direct impact to two threatened biodiversity species that are regarded as 'species credits' as per the requirements of the BAM: Cumberland Plain Land Snail, and Southern Myotis.

A further 35 threatened fauna species are predicted in the BAM Calculator (BAM-C) to have foraging habitat within the PCTs of the proposal area. Such species are regarded as 'ecosystem credit' fauna that do not require any further consideration in a BDAR.

Avoid, Minimise and Mitigate

TfNSW have aimed to avoid and minimise environmental impacts from the proposal as far as practical through options analysis and design refinement to reduce impacts. A series of mitigation measures to manage potential indirect impacts from the proposal would also be employed in accordance with TfNSW Biodiversity Guidelines.

Biodiversity offsetting

The unavoidable impacts of the proposal on ecological values includes the clearing of about 9.38 hectares of vegetation regarded as 'native vegetation,' as defined in the BAM, and associated fauna habitat.

Through the application of the BAM, associated guidelines and the BAM-C, the following biodiversity credit offsets are required to offset the unavoidable impacts:

- 124 credits for PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- 110 credits for PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- 8 credits for PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
- 160 credits for Southern Myotis
- 86 credits for Cumberland Plain Land Snail.

Assessments of significance under the EPBC Act were also completed for threatened biodiversity (Cumberland Plain Woodland, River-flat Eucalypt Forest, Yellow Wagtail, and Grey-headed Flying-fox) likely to be impacted by the proposal. Given the proposal is being undertaken by TfNSW under Division 5.1 of the EP&A Act, the strategic assessment applies, and no further Referral and associated offsets under the Commonwealth are required.

Glossary

Definitions

Accredited person or assessor	Means as person accredited under section 6.10 (of the BC Act) to prepare reports in accordance with the BAM.
Biodiversity credit report	The report produced by the BAM-C that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (DPIE 2020).
Biodiversity offsets	The gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development (DPIE 2020)
Biodiversity Stewardship site	Refers to land which is the subject to a Biodiversity Stewardship Site agreement under the BC Act
Bionet Vegetation classification	Refers to the vegetation community-level classification for use in vegetation mapping programs and regulatory biodiversity impact assessment frameworks in NSW. The BioNet Vegetation Classification is published by the Department and available at www.environment.nsw.gov.au/research/Visclassification.htm .
Biodiversity Offsets and Agreement Management System	The system used to administer the Biodiversity Offsets Scheme. BOAM is used to access the version of the Calculator that can be used to perform and submit BAM assessments, submit BAM related applications, generate a credit obligation, calculate a credit price or apply to sell or retire credits.
BioNet Atlas	The DPIE database of flora and fauna records (formerly known as the NSW Wildlife Atlas). The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails listed under the BC Act) and some fish (DPIE 2020).
Calculator or BAM-C	Biodiversity Assessment Method Calculator – a tool that applies the BAM to calculate the number and type of credits required to offset the impacts of development on biodiversity or credits generated at a biodiversity stewardship site.
Cumulative impact	The extent to which the development or activity contributes to the cumulative impacts of existing and planned developments or activities on threatened species, ecological communities, habitats, Areas of Outstanding Biodiversity Value and key threatening processes.
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat, and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (the BC Regulation) (DPIE 2020)

Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credits	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity certification site and the gain in biodiversity values at a biodiversity stewardship site (DPIE 2020).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	Impacts that occur when the proposal affects native vegetation and threatened species habitat beyond the development footprint or within retained areas (e.g. transporting weeds or pathogens, dumping rubbish). This includes impacts from activities related to the construction or operational phase of the proposal and prescribed impacts (DPIE 2020).
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act (Cth)
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (DPIE 2020).
Mitigation	Action to reduce the severity of an impact (OEH 2014).
Native vegetation	(a) trees (including any sapling or shrub or any scrub), (b) understorey plants , (c) groundcover (being any type of herbaceous vegetation), (d) plants occurring in a wetland. A plant is native to New South Wales if it was established in New South Wales before European settlement (BC Act).
PlantNET NSW	An online database of the flora of New South Wales which contains currently accepted taxonomy for plants found in the State, both native and exotic.
Population	A group of organisms, all of the same species, occupying a particular area (DPIE 2020).
Proposal area	The area of land that is directly impacted on by the proposal that is being assessed under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014). It includes the construction and operational areas for the proposal.
Spatial datasets	Spatial databases required to prepare a BDAR <ul style="list-style-type: none"> ○ BioNet NSW (Mitchell) Landscapes – Version 3.1 ○ NSW Interim Biogeographic Regions of Australia (IBRA region and sub-regions) – Version 7 ○ NSW soil profiles

	<ul style="list-style-type: none"> ○ hydrogeological landscapes ○ acid sulfate soils risk ○ digital cadastral database ○ Vegetation Information Systems maps ○ Geological sites of NSW.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Target species	A species has been identified within the assessment area or is considered to have a moderate to high likelihood of occurrence and may be impacted by the proposal.
Threatened Biodiversity Data Collection	<p>A publicly assessable online database (registration required) which contains information for listed threatened species, populations and ecological communities.</p> <p>Part of the BioNet database, published by EES and accessible from the BioNet website at www.bionet.nsw.gov.au.</p>
Vegetation clearing boundary	The area of vegetation to be directly impacted by the proposal during construction activities.

Abbreviations

AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offset Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and the Environment
DIWA	Directory of Important Wetlands in Australia
DPIE	Department of Planning, Industry and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EES	NSW Environment Energy and Science Group within the Department of Planning, Industry and Environment
Environment Agency Head	Environment Agency Head, Environment, Energy and Science Group, Department of Planning, Industry and Environment
EP&A Act	<i>Environment Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).</i>
Fisheries NSW Policy and Guidelines	Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
PCT	Plant Community Type

REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SAII	Serious and Irreversible Impacts
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened ecological communities (VECs, EECs and CEECs)
TfNSW	Transport for NSW
VEC	Vulnerable Ecological Community
VIS	Vegetation information system

1 Introduction

1.1 Proposal overview

Transport for NSW (TfNSW) proposes to upgrade about 3.8 kilometres of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park to a four-lane divided road (the proposal). The proposal is located within the City of Penrith local government area (LGA) in Sydney, New South Wales (NSW). The proposal forms Stage 1 of the larger Mamre Road Upgrade Project, which is proposed to be delivered by TfNSW in two stages. Overall, the Mamre Road Upgrade Project would involve upgrades to a 10 kilometre long section of Mamre Road between the M4 Motorway, St Clair and Kerrs Road, Kemps Creek.

Mamre Road is a key transport corridor, which provides connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis. A key aim of the proposal is to improve road safety and movement between the M4 Motorway and Erskine Park Road through increasing the capacity of Mamre Road, which would support future economic and residential growth in the surrounding area.

The proposal would involve widening Mamre Road from one lane either direction to two lanes in each direction. The proposal includes changes and upgrades to existing intersections and new facilities for public transport, walking and cycling along Mamre Road. Sufficient space within the road corridor would also be provided for an additional lane in each direction if required in the future.

Niche Environment and Heritage Pty Ltd (Niche) has been commissioned to prepare a Biodiversity Development Assessment Report (BDAR) to support the Review of Environmental Factors (REF) for the proposal.

This BDAR complies with the Biodiversity Assessment Methodology (BAM) (DPIE 2020a) to adequately assess potential impacts to threatened biodiversity listed on the NSW *Biodiversity Conservation Act 2016* (BC Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The process of completing this BDAR has also supported the planning and design development of the proposal including identifying environmental risks, constraints and areas of sensitivity and making recommending for the avoidance or minimisation of potential impacts.

1.2 The proposal

The proposal includes the upgrade of about 3.8 kilometres of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, and Erskine Park (Figure 1).

The proposal has been designed to NSW and Australian engineering, road safety, environmental and transport planning standards developed by Transport for NSW, Austroads and Standards Australia.

Key features of the proposal have been discussed in detail in the REF for the proposal and include (shown on Figure 2):

- an upgrade of Mamre Road to a four-lane divided road with a wide central median that would allow for widening to six lanes in the future, if required
- changes to intersections with Mamre Road including:
 - an upgrade to the existing signalised intersection at Banks Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Solander Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Luddenham Road with new turning lanes
 - an upgrade to the existing signalised intersection at Erskine Park Road with new turning lanes
 - modified intersection arrangements (left in, left out only) at McIntyre Avenue and Mandalong Close

- a new shared path along the eastern side of Mamre Road and provision for a future shared path on the western side
- reinstatement of bus stops near Banks Drive with provision for additional bus infrastructure in the future
- changes to property access to Mamre House, Erskine Park Rural Fire Service and other private properties
- drainage and flooding infrastructure upgrades including culvert crossings, water quality basins, grass swales and channel tail-out work
- new traffic control facilities including new traffic signals and relocation of existing electronic variable message signage
- roadside furniture and street lighting
- noise walls along the eastern side of Mamre Road at St Clair
- utility relocations
- establishment of temporary ancillary facilities to support construction including compound sites, stockpile and laydown locations, temporary access tracks, temporary waterway crossings and concrete batching plants.

Construction of the proposal is expected to start in 2022 and be completed in late 2025, subject to approval, funding and weather considerations.

Construction of the proposal is planned to be carried out in two stages: early work and main construction work. Early work would involve utility relocations, site establishment activities, property adjustments and other low impact work required to facilitate construction.

The key proposal objectives are to:

- improve road safety in line with the *NSW Road Safety Strategy 2012-2021 Safe System Directions and Safer Roads Key Focus*
- improve movement and travel times between the M4 Motorway and Erskine Park Road for general traffic, freight and bus services operating along the corridor
- support economic growth and productivity by providing increased road capacity for the projected traffic volumes on Mamre Road
- improve quality of service, sustainability and liveability by providing facilities for walking, cycling and future public transport needs and improving the urban design of the road corridor
- maintain a safe and efficient environment for all road users.

1.3 Defining the proposal area and vegetation clearance boundary

The proposal area for the proposal contains all areas proposed for ground disturbance (including construction and operation) and encompasses the key infrastructure elements as summarised in section 1.2, and detailed in the REF for the proposal (Figure 1).

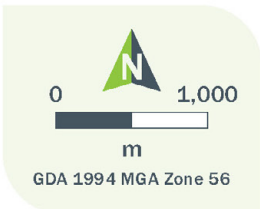
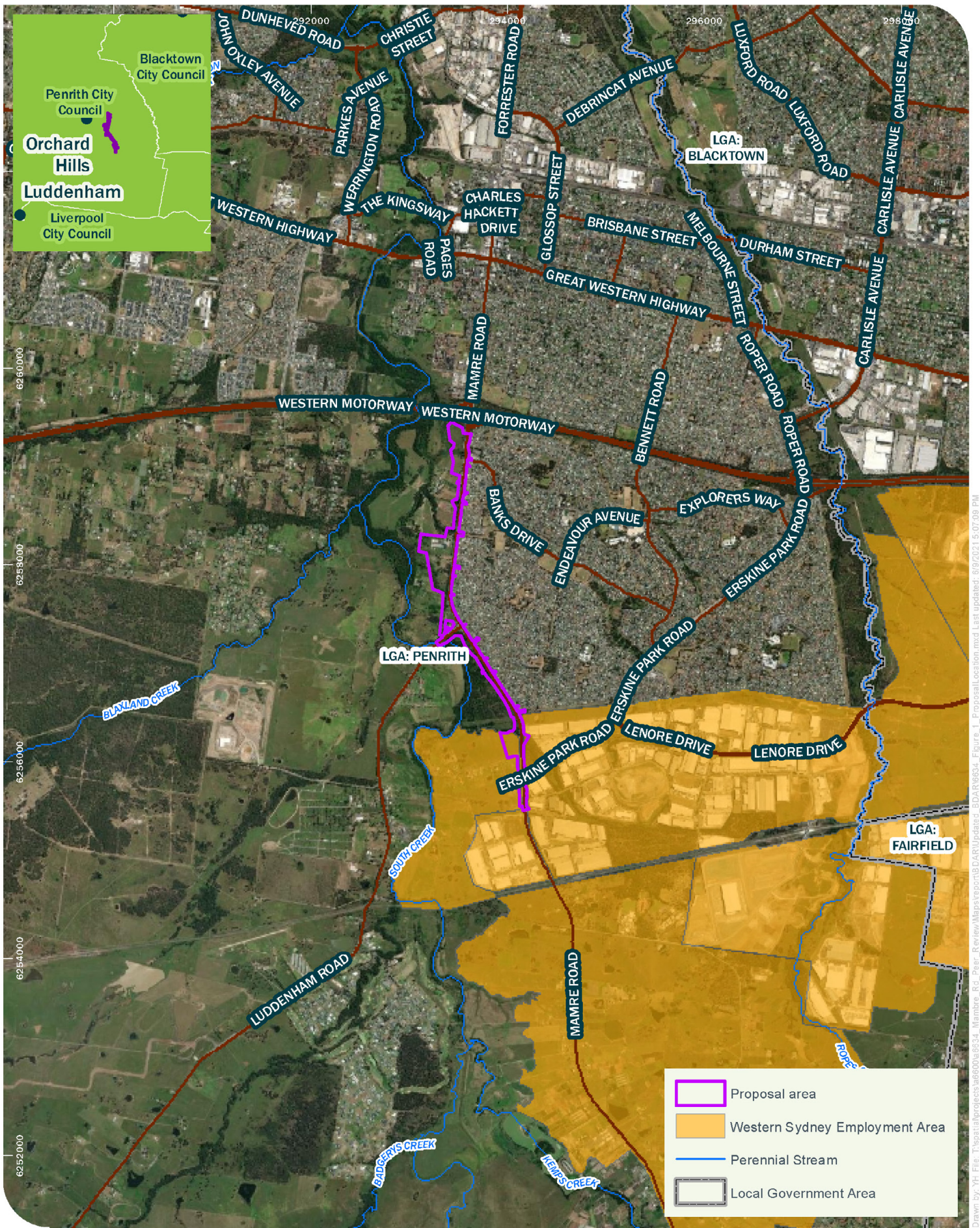
The proposal area is about 44.85 hectares, which includes the operational footprint (the Mamre Road upgrade, associated median, drainage and all associated infrastructure for the ongoing operation of the proposal) and includes establishment of temporary ancillary facilities to support construction including compound sites, stockpile and laydown locations, temporary access tracks, temporary waterway crossings and concrete batching plants.

The cleared area within the proposal area is about 35.46 hectares, which consists of non-native vegetation, the existing Mamre Road and easement, and surrounding agricultural/residential land and infrastructure services.

Native vegetation occupies about 9.38 hectares of the proposal area, which predominately consists of scattered native eucalypts as discussed in section 3.

Much of the native vegetation to the north of the proposal area consists of patches of native vegetation that are relatively small (0.3 to 0.8 hectares), owing to the historic vegetation clearing that has occurred. To the south of the proposal area, the connectivity of habitat is more prominent given the Luddenham BioBank site (BA408) occurs immediately adjacent to the existing Mamre Road corridor. The design of the proposal and the implementation of relevant mitigation measures assist in preventing and/or minimising potential indirect impacts to the existing BioBank site (section 8).

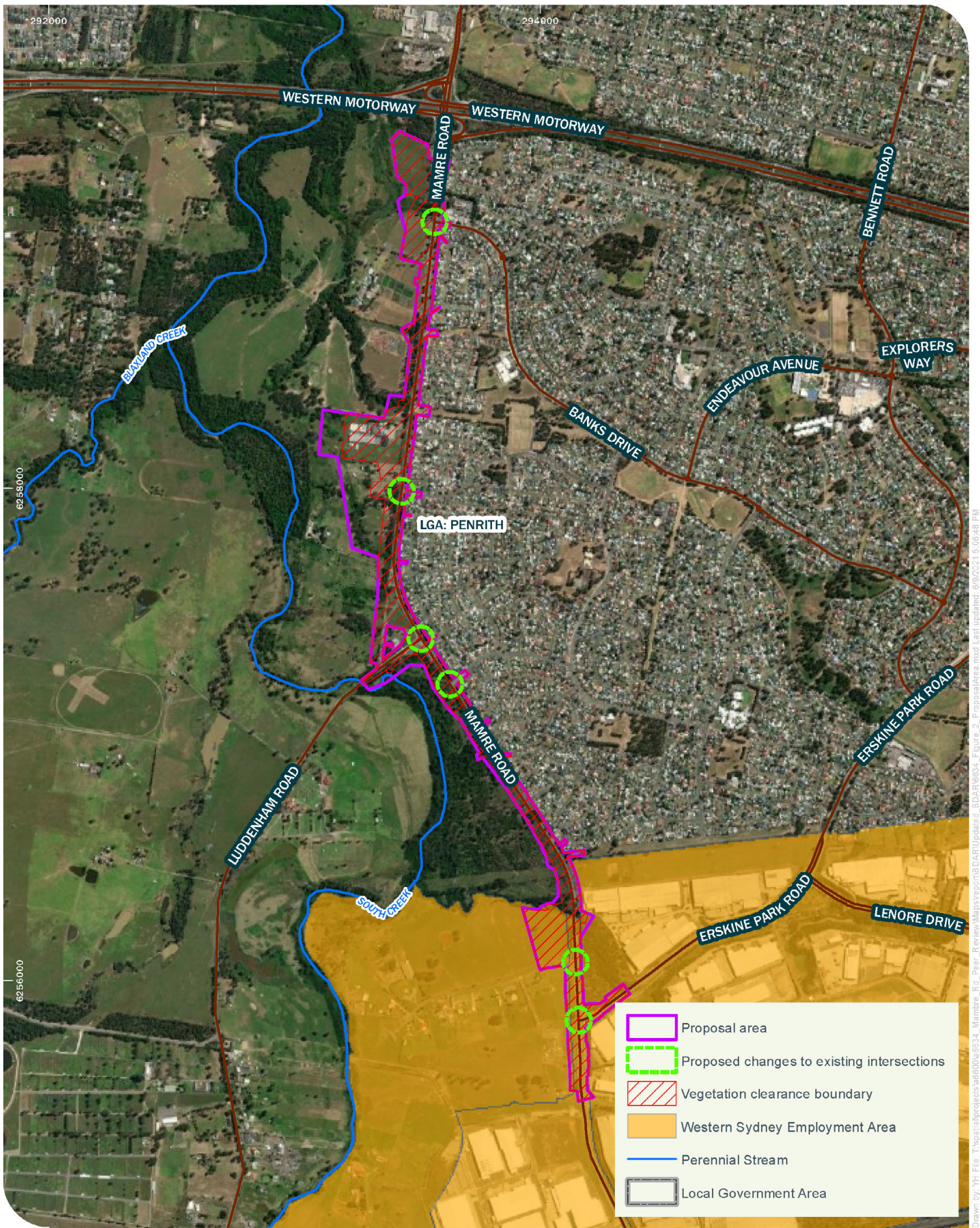
The vegetation clearance boundary is associated with the native vegetation that must be cleared to support the proposal. The vegetation clearance boundary is the area of direct impact, which has discussed in section 7, and is shown on Figure 3.



Location of proposal
Biodiversity Development Assessment Report (BDAR)

Niche PM: Luke Baker
Niche Proj. #: 6634
Client: Transport for NSW / Aurecon

Figure 1



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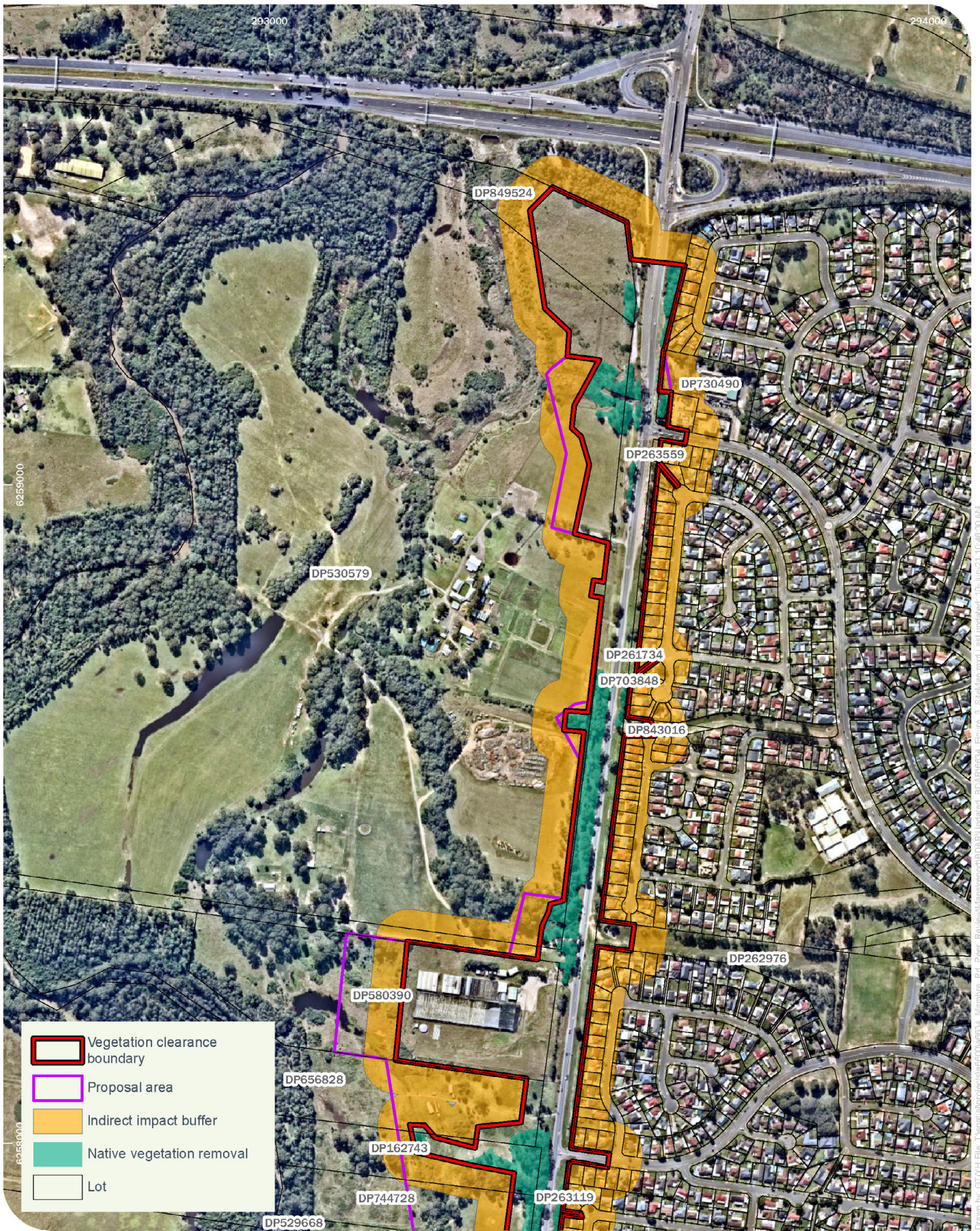


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The proposal area
 Biodiversity Development Assessment Report (BDAR)

Figure 2

World Imagery: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Nearthmap 2020



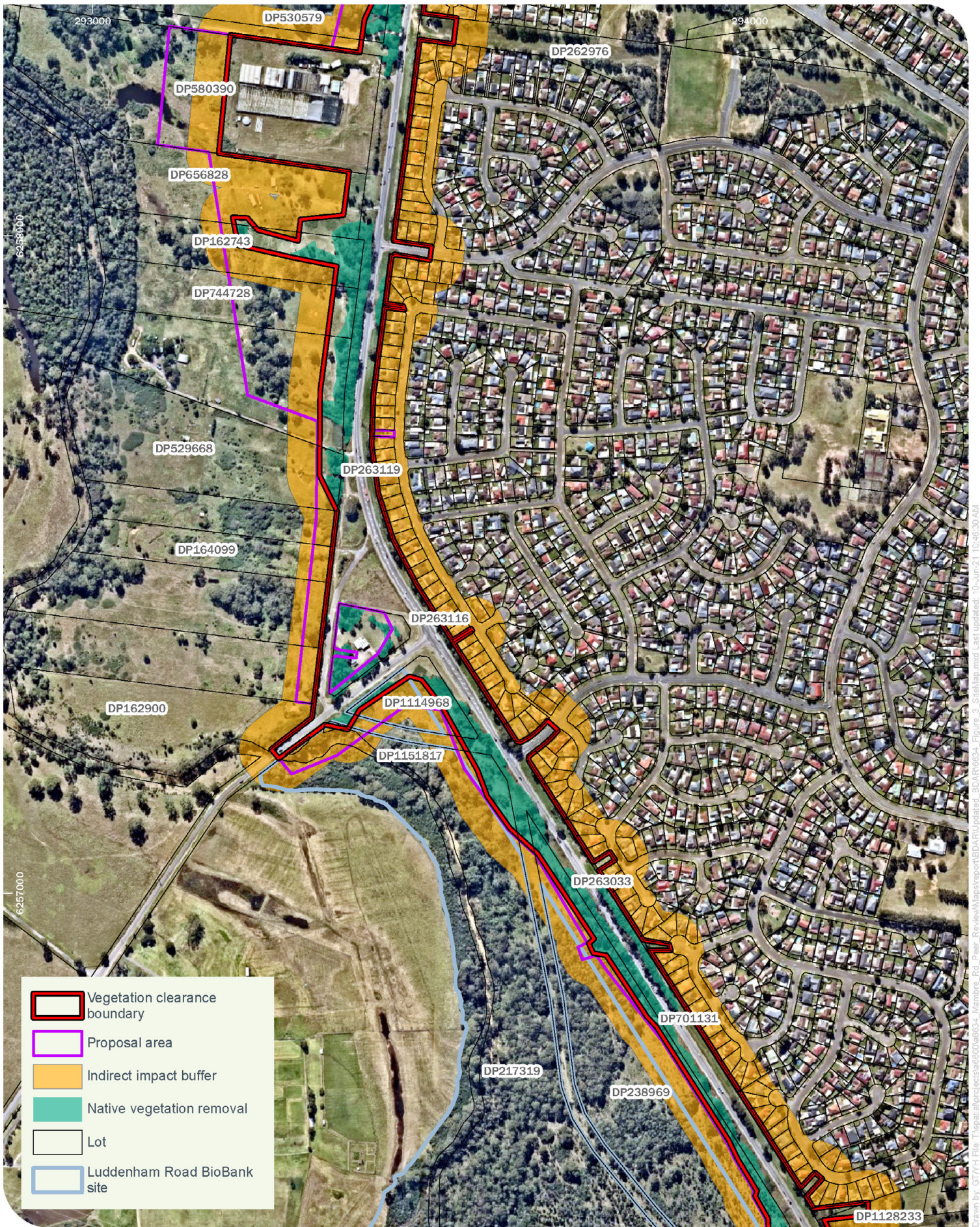
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The proposal area and vegetation clearance boundary
 Mamre Road Upgrade – Stage 1
 Biodiversity Development Assessment Report (BDAR)

Niche PM: Luke Baker
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Figure 3.1



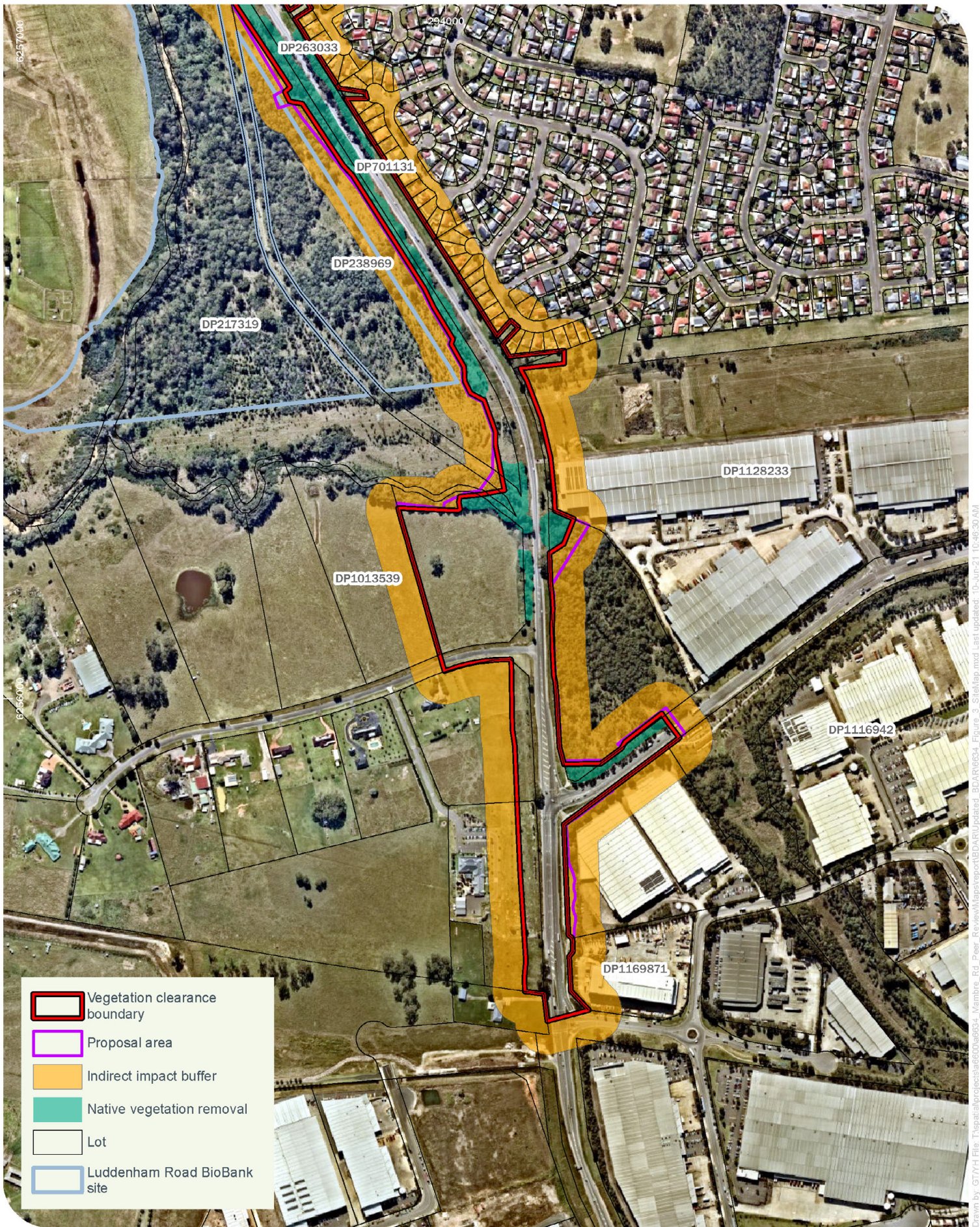
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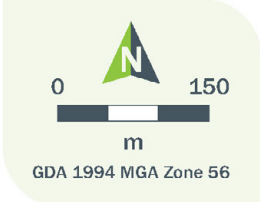
The proposal area and vegetation clearance boundary
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Biodiversity Development Assessment Report (BDAR)

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Figure 3.2



-  Vegetation clearance boundary
-  Proposal area
-  Indirect impact buffer
-  Native vegetation removal
-  Lot
-  Luddenham Road BioBank site



The proposal area and vegetation clearance boundary
Mamre Road Upgrade – Stage 1
Biodiversity Development Assessment Report (BDAR)

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Figure 3.3

1.4 Legislative context

1.4.1 Biodiversity Conservation Act 2016

The *NSW Biodiversity Conservation Act 2016* (BC Act) came into effect on the 25 August 2017. This Act repealed the *Threatened Species and Conservation Act 1995* (TSC Act), *Native Vegetation Act 2003* and parts of the *National Parks and Wildlife Act 1974*. All threatened entities previously listed under the TSC Act have now been listed under the schedules of the BC Act.

The BC Act outlines the framework for addressing impacts on biodiversity from development and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme. The Biodiversity Offsets Scheme creates a transparent, consistent and scientifically based approach to biodiversity assessment and offsetting for all types of development that are likely to have a significant impact on biodiversity.

The Biodiversity Offsets Scheme is not mandatory for activities approved under Division 5.1 of the EP&A Act although the determining authority must be satisfied that the proposed activity is unlikely to significantly affect threatened species in accordance with Section 7.3 of the BC Act.

Given the proposal would result in significant impacts to threatened biodiversity, in particular the impact to Cumberland Plain Woodland, TfNSW have decided to 'opt' into the BDAR process, which ensures that suitable biodiversity offsets are provided for impacts to threatened biodiversity as per the requirements of the BAM.

1.4.2 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations to:

- Conserve fish stocks and key fish habitats;
- Conserve threatened species, populations and ecological communities of fish and marine vegetation; and
- Promote ecologically sustainable development, including the conservation of biological diversity.

Protection is provided by integrating the conservation of threatened species, endangered populations and EEC/CEECs into development control processes under the EP&A Act.

Part 7A Division 4 of the FM Act prohibits, without a licence or permit, activities that damage habitats or harm threatened species, populations or ecological communities.

The proposal would impact the tributaries of South Creek which is an identified 'Key Fish Habitat' (KFH) under the FM Act (discussed in section 4.3.2).

1.4.3 EPBC Act Assessment Requirements

Matters of National Environmental Significance (MNES) are protected under the EPBC Act. The BAM requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be present on or near the development site. Therefore, the BAM has partly been used to perform assessment of impacts under the EPBC Act.

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to TfNSW activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. Obligations arising from the approval have been incorporated into TfNSW environmental impact assessment procedures, guidelines and templates.

The practical effect of the approval is that TfNSW projects assessed via an REF:

- Must address and consider potential impacts on nationally listed threatened species, populations, ecological communities and migratory species, including application of the “avoid, minimise, mitigate and offset” hierarchy.
- Do not require referral to the Federal Department of Agriculture, Water and Environment (DAWE) for these matters, even if the activity is likely to have a significant impact.

Given the proposal being undertaken by TfNSW under Division 5.1 of the EP&A Act, the strategic assessment applies. This BDAR provided an assessment for threatened biodiversity listed on the EPBC Act throughout sections 5 and 7, including further assessment of impacts under the EPBC Act undertaken via assessments of significance for EPBC Act listed species with the potential to be affected by the proposal (Annexure E). Avoidance and mitigation measures have also been described in section 6 and 8.

1.5 Assessment guidelines used in this report

The assessment presented in this BDAR was undertaken in accordance with the BAM and has considered and applied where relevant, the following guidelines throughout the course of the field work and reporting:

NSW survey guidelines

- DPIE (2020b), Surveying threatened plants and their habitats. NSW survey guide for the Biodiversity Assessment Method.
- DPIE (EES) (2020c), NSW Survey Guide for Threatened Frogs. A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method
- OEH (2018a), Biodiversity Assessment Method Operational Manual – Stage 1.
- OEH (2018b), ‘Species credit’ threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method.

National survey guidelines

- Commonwealth of Australia (2010a) Survey Guidelines for Australia’s Threatened Bats.
- Commonwealth of Australia (2010b) Survey Guidelines for Australia’s Threatened Birds.
- Commonwealth of Australia (2011a) Survey Guidelines for Australia’s Threatened Frogs.
- Commonwealth of Australia (2011b) Survey Guidelines for Australia’s Threatened Mammals, Commonwealth of Australia.
- Commonwealth of Australia (2011c) Survey Guidelines for Australia’s Threatened Reptiles
- Commonwealth of Australia (2013) Draft survey guidelines for Australia's threatened orchids.

1.6 Personnel

This BDAR has been approved for submission by Niche. The Niche Assessors and Aurecon staff that have been involved in the preparation of this BDAR include those listed in Table 1-1.

All staff involved in the preparation of this BDAR are appropriately qualified and experienced environmental professionals as demonstrated in Table 1-1.

Table 1-1: Personnel

Name	Role	Years of experience	Qualifications
Luke Baker	Project management, and quality Assurance	15	Bachelor of Applied Science (Environmental Management), Accredited BAM Assessor (BAAS17033)
Dr Amanda Griffith	Fauna field survey and quality assurance	18	Bachelor of Science (Hons), PhD, Accredited BAM Assessor (BAAS19016)
Patrick McEvoy	Biodiversity credit calculations	5	Bachelor of Science Accredited BAM Assessor (BAAS20018)
Dr Jai Green-Barber	Fauna field surveys and report writing	3	PhD, Bachelor of Science Accredited BAM Assessor (BAAS20002)
Isabel Lyons	Flora and fauna surveys, flora surveys and report writing	2	Bachelor of Science
Annabel Grundy	Fauna surveys, flora surveys, data management	1	Bachelor of Science
Kayla Asplet	Anabat analysis	5	Bachelor of Science (Honours)
Sarah Glauert (Aurecon)	Field surveys – Fauna	13	Bachelor of Science (Conservation Biology) Accredited BAM Assessor (BAAS17097)
Paul Gadsby (Sole-trader)	Field surveys	5	Accredited BAM Assessor (BAAS20010) Bachelor of Science (Environmental Science) Masters of Conservation Biology
Janelle So (Aurecon)	Field surveys – Fauna	1	Bachelor of Advanced Science (Honours) (Biology and Ecology)

Name	Role	Years of experience	Qualifications
Liam Stephen (Aurecon)	Field surveys	1	Bachelor of Science (Land Resources) (Environmental Science) (Honours)

1.7 Structure of this report

The primary objective of this assessment is to prepare a BDAR for the proposal that is consistent with the BAM and associated guidelines. This BDAR details the impact the proposal would have on biodiversity; details the avoidance and mitigation measures proposed; and calculates the proposal's biodiversity offset requirement.

The structure of the report is outlined below:

- Section 1 – Introduction – Provides an introduction to the report
- Section 2 – Landscape features – Describes the landscape features of the proposal area
- Section 3 – Native vegetation – Describes vegetation within the proposal area
- Section 4 –Threatened species – Describes threatened species listed under the BC Act and habitat in the proposal area
- Section 5 – Matters of National Environmental Significance – Describes relevant Matters of Environmental Significance
- Section 6 – Avoidance and minimise impacts
- Section 7 – Impact Assessment – Describes the unavoidable construction and operation impacts of the proposal
- Section 8 – Mitigation measures – Outlines mitigation measures to minimise impacts
- Section 9 – Offsetting – Describes the proposal's offset requirements
- Section 10 – Conclusion – Presents the conclusions of the assessment
- Section 11 – References – Presents the list of reference documents used in the assessment.

2 Landscape features

2.1 Identified features

As detailed in Section 4 of the BAM, a landscape assessment for the proposal is required, which was conducted within the BAM Calculator (BAM-C). Landscape value is an assessment of factors including:

- Native vegetation cover
- Rivers, streams and estuaries
- Areas of geological significance
- Habitat connectivity.

For each factor the current state of the landscape is assessed and then compared with the state of the landscape if the proposal were to proceed.

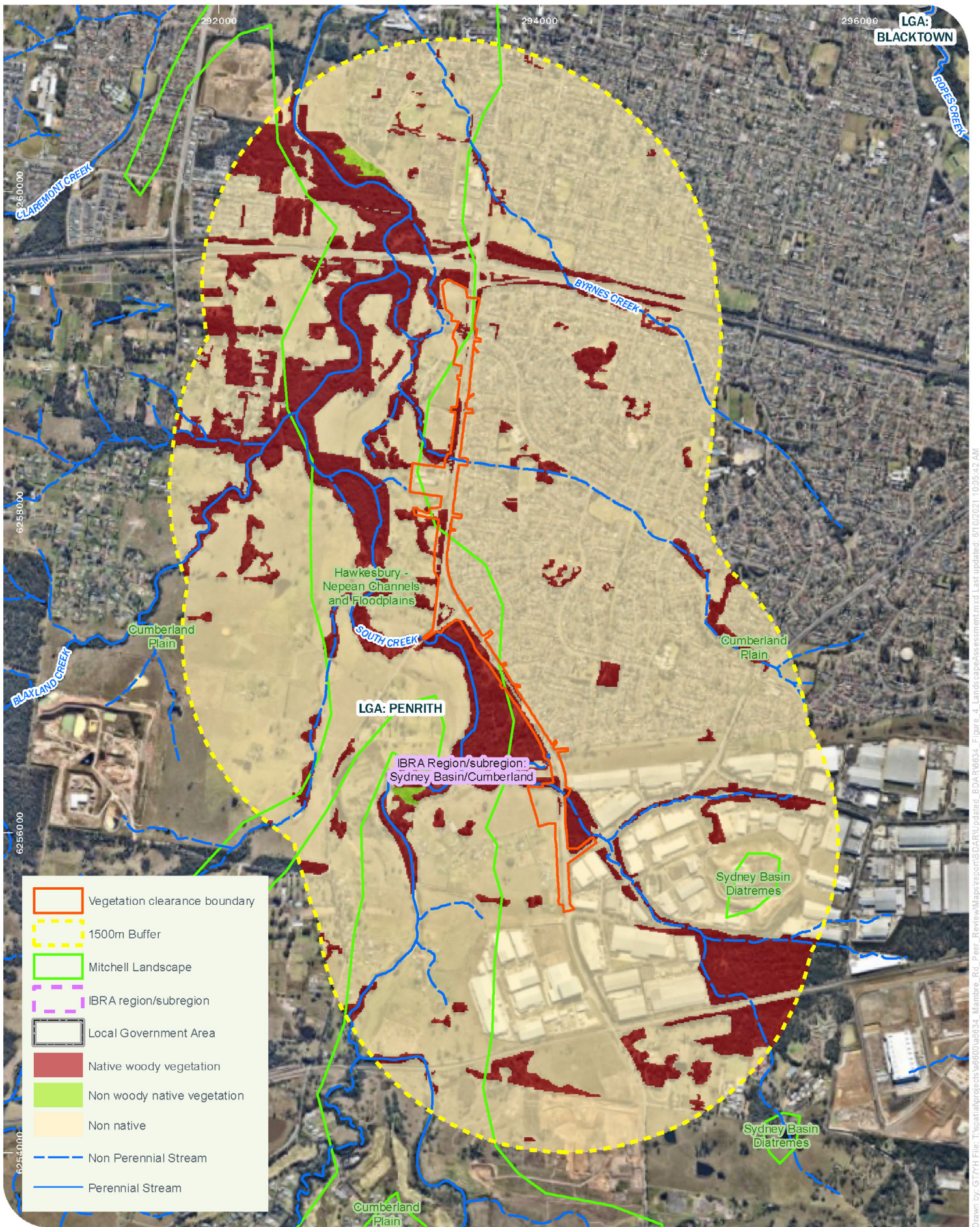
The landscape features have been described in Table 2-1, along with the associated Figure references.

Table 2-1: Landscape features

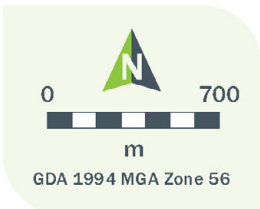
Landscape feature	Description	Figure reference
IBRA bioregions and subregions	The proposal is located within the Sydney Basin IBRA Bioregion; and the Cumberland IBRA Subregion.	Figure 4
NSW landscape regions (Mitchell landscapes)	<p>Two NSW landscape regions (Mitchell landscapes) occur across the proposal area. The regions are described by Mitchell (2002):</p> <ol style="list-style-type: none"> i. Hawkesbury – Nepean Channels and Floodplains: which is described as a meandering channel and moderately wide floodplain of the Hawkesbury and Nepean Rivers. Quaternary sand and gravel, general elevation 0 to 20 metres, local relief less than 10 metres. Undifferentiated alluvial sand to poorly structured gradation profiles of sandy loam or clay loam. ii. Cumberland Plain: which is described as low rolling hills, small number of volcanic vents, partly covered by Tertiary river gravels and sands, general elevation 30 to 120 metres, local relief 50 metres. Pedal uniform red to brown clays on volcanic hills. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys. <p>The Cumberland Plain landscape region (Mitchell landscape) occupies the majority of the proposal area (about 29 ha) compared to the Hawkesbury – Nepean Channels and Floodplains (about 17 ha).</p> <p>The Cumberland Plain landscape region (Mitchell landscape) was therefore entered into the BAM-C.</p>	Figure 4

Landscape feature	Description	Figure reference
Native vegetation extent in the buffer area	<p>In accordance with the BAM, and assessor must determine the extent of native woody vegetation, native grasslands, and non-native vegetation with a 1,500 m buffer applied to the proposal area.</p> <p>A 1,500 m buffer was applied to the proposal area resulting in an overall buffer area of 2,104 ha. Aerial interpretation was used to map the area of native vegetation, and non-native vegetation within the buffer area.</p> <p>In total, areas devoid of native vegetation (cleared areas)/existing infrastructure/areas that would be classified in the BAM as 'non-native vegetation') occupies 1,736 ha of the buffer area.</p> <p>Native woody vegetation comprises of about 363 ha, which includes the following areas of native vegetation that occur within the proposal area:</p> <ul style="list-style-type: none"> iii. 4.55 ha of Cumberland shale plains woodland (PCT 849) iv. 4.36 ha of Cumberland riverflat forest (PCT 835) v. 0.47 ha of Cumberland Swamp Oak riparian forest (PCT 1800). <p>Based on aerial photography interpretation, we have estimated that there is about five hectares of native grassland.</p> <p>The area of native vegetation (native woody and native grassland) within the 1,500 metre buffer therefore covers 17.5 percent of the buffer area (368 hectares of 2,104 hectares). The percentage of 18 percent (rounded) was entered into the BAM-C as the extent of native vegetation.</p>	Figure 4
Cleared areas	As detailed above, the area of non-native vegetation or cleared land/existing infrastructure is about 1,736 ha. Within the proposal area, approximately 35.46 ha of non-native vegetation/cleared land is present (Table 3-2). This is associated predominately with Mamre Road, road easements, and surrounding agricultural/residential land and infrastructure services.	Figure 4
Rivers and streams	<p>The proposal area includes a portion of South Creek as shown on Figure 4.</p> <p>The proposal would have a minor direct impact to South Creek due to the construction of headwalls that outlet to South Creek.</p> <p>The proposal design and mitigation measures detailed in section 8 have minimised impacts to watercourses.</p>	Figure 4
Wetlands	No wetlands are mapped within the proposal area, however it is noted that there is one small area of native vegetation that contains native species that can inhibit waterlogged areas (eg. <i>Juncus</i> spp. <i>Persicaria</i> spp.). This area is shown on Figure 5 as PCT 849 which has been attributed to 'low condition' class given it has been historically cleared and is in a regenerating state. The impacts to this patch of PCT 849 low has been addressed in section 7.	Figure 4

Landscape feature	Description	Figure reference
Connectivity features	<p>In a larger regional context, the proposal area is surrounded by residential development to the east, and a mix of residential/rural landscapes to the west. The key biodiversity feature within the locality is the vegetation along South Creek. South Creek provides an important fauna corridor throughout Western Sydney, and provides informal protection for native vegetation, comprising largely of TECs typical of Western Sydney. The South Creek riparian corridor connects the site to Wianamatta Regional park about 5.5 km to the north of the proposal area.</p> <p>The native vegetation across much of the proposal area consists of scattered eucalypts which align to the PCTs detailed in section 3.2.</p> <p>The proposal would impact the edge of existing patches of native vegetation.</p> <p>Much of the native vegetation to the north of the proposal area consists of patches that are relatively small (0.3 ha to 1 ha), owing to the historic vegetation clearing that has occurred. These areas provide 'island' habitat, or 'stepping-stones' for fauna between other similar scattered patches to the west. Given the isolation of these patches and exposure to edge effects from Mamre Road and surrounding land uses, the patches contain a large percentage of weed coverage and evidence of erosion and rubbish dumping.</p> <p>To the south of the proposal area, the connectivity of habitat is more prominent given the native vegetation of the site is adjoined to larger native patches. To the south of Luddenham Road, the proposal occurs immediately adjacent to the Luddenham Road BioBank site. This site contains over 40 ha of native vegetation that will be protected in-perpetuity. About 0.02 ha along the north-east corner of the Luddenham Road BioBank site would be impacted by the proposal.</p>	Figure 4
Areas of Geological Significance	<p>The proposal area is located on relatively flat terrain within the Cumberland Plain. No rocky outcrops, crevices or cliffs are located within the proposal area or immediately adjacent. The proposal would therefore not have an impact upon areas of geographical significance.</p>	N/A
Areas of outstanding biodiversity value	<p>The Register of Declared Areas of Outstanding Biodiversity Value has information about declared Areas of Outstanding Biodiversity Value in NSW. Area of Outstanding Biodiversity Value declarations in NSW include the following:</p> <ul style="list-style-type: none"> • Gould's Petrel – critical habitat declaration • Little penguin population in Sydney's North Harbour – critical habitat declaration • Mitchell's Rainforest Snail in Stotts Island Nature Reserve – critical habitat declaration • Wollemi Pine – critical habitat declaration. <p>None of the areas of Outstanding Biodiversity Value that are listed above would be impacted by the proposal, given none are located within the proposal area.</p>	N/A



Drawn by: G7YH File: T:\Spatial\projects\6600\ae634_Mamre_Rd_Per_Review\Map\report\BDAR\Updated_BDA_R\6634_Figure_4_LandscapeAssessment.mxd Last updated: 6/10/2021 10:05:42 AM



Niche PM: Luke Baker
Niche Proj. #: 6634
Client: Transport for NSW / Aurecon

Landscape Assessment
Mamre Road Upgrade – Stage 1
Biodiversity Development Assessment Report (BDAR)

Figure 4

3 Native vegetation

3.1 Method

3.1.1 Background research

A review of relevant literature, databases and existing vegetation mapping was undertaken to identify vegetation, threatened flora and Threatened Ecological Communities (TECs) that are listed under both NSW and Commonwealth legislation, with potential to occur at the proposal area. The literature review was undertaken prior to the field survey to inform field survey requirements. A likelihood of occurrence analysis (Annexure 1) was then undertaken for each species/TEC, based on suitability of habitat present within the proposal area.

The following databases were used for this purpose:

- Department of Planning, Infrastructure and the Environment (DPIE) BioNet, Atlas of NSW Wildlife (DPIE 2019b)
- Department of Agriculture, Water and Environment (DAWE) EPBC Act Protected Matters Search Tool Report (DoEE 2019a)
- Threatened Species Collection Database (DPIE 2021)
- BAM-C outputs.

3.1.2 Vegetation survey undertaken

Prior to field validation, the proposal area was stratified using aerial photographic interpretation (API), and existing vegetation mapping projects, such as the Cumberland Plain Mapping Project (NPWS 2002, Tozer et al 2003).

Following a review of the existing mapping, field surveys were carried out on 16 to 18 September 2020, 22 February, 26 February 2021, 30 March 2020, 14 April 2021, 29 April 2021 and 4 May 2021, to stratify the vegetation as per the BAM.

In total, nine BAM plots were completed within the proposal area to meet the minimum plot requirement as per the BAM (Table 3-1 and Figure 5). Several transects were also completed, which assisted in vegetation zone delineation and the vegetation mapping validation.

Table 3-1: Minimum number of plots required and completed per zone area

PCT Code / vegetation zone	Vegetation zone area (ha)	Plots required	Plots completed
PCT 849_medium	3.63	2	2
PCT 849_low	0.92	1	1
PCT 835_medium	2.84	2	2
PCT 835_low	1.52	1	3
PCT 1800_medium	0.47	1	1
Total	9.38	7	9

3.1.3 Limitations

Numerous plant and animal species are cryptic or difficult to detect. Some cryptic plant species are more easily detected at certain times of the year, such as during flowering events. Some fauna can only be detected during certain seasons (e.g. migration patterns or intra-torpor periods). These limitations were addressed by undertaking surveys across differing months, analysis species specific habitat, employing a range of trapping and survey techniques.

3.2 Vegetation mapping results

The vegetation survey confirmed the presence of three PCTs within the proposal area:

- PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

Different condition classes were assigned to areas of vegetation where obvious differences in structure and quality occurred, resulting in three PCTs and five vegetation categories (zones) as shown in Table 3-2.

In general, all five vegetation zones reflected the edge effects from the existing road, including weed occurrence, sedimentation, erosion and some debris. Additionally, historical and current clearing for agricultural purposes is evident across the site.

Where areas of PCT 849 and PCT 835 were small and isolated, the condition was generally lower, with less canopy cover, lower species diversity and typically higher abundance of exotic species.

The vegetation within the BioBank site directly south of Luddenham Road and the vegetated area directly north of Erskine Park Road were in a moderate condition. The canopy in these patches typically comprised trees of 30 centimetre diameter breast height (dbh), some mature (<80 dbh), as well as regenerating tree species were observed throughout the moderate condition vegetation.

Typically, the dominant eucalypts within the proposal area consisted of Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box (*Eucalyptus moluccana*), with some occurrences of Swamp Sheoak (*Casuarina glauca*), and White Feather Honey Myrtle (*Melaleuca decora*). The mid to ground cover of the proposal area had relatively high instances of Blackthorn (*Bursaria spinosa*), Kidney Weed (*Dichondra repens*), Twining Glycine (*Glycine clandestina*), Weeping Grass (*Microlaena stipoides*), and Forest Nightshade (*Solanum prinophyllum*).

Table 3-3 to Table 3-7 detail the condition of each vegetation zone as well as species composition, conservation status and landscape characteristics.

A full species list for all surveyed plots is found in Annexure B, and the extent of vegetation within the proposal area is shown in Figure 5.

Table 3-2 Plant community types by vegetation zone

Vegetation Zone	Plant community type (PCT)	Vegetation Formation	Vegetation Class	Threatened Ecological Community ¹	PCT Cleared Extent	Condition identified (Used in BAM-C)	Vegetation integrity score	Patch size (ha)	Area (ha) within vegetation clearance boundary
849_medium	PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	Yes - aligns to the CEEC Cumberland Plain Woodland (BC and EPBC Act)	93	Medium	48.6	101	3.63
849_low	PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	Yes - aligns to the CEEC Cumberland Plain Woodland (BC Act)	93	Low	7.6	101	0.92
835_medium	PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	Yes - aligns to River-Flat Eucalypt Forest (a CEEC under the BC Act and a EEC under the EPBC Act)	93	Medium	72.4	101	2.84
835_low	PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	Yes - aligns to River-Flat Eucalypt Forest (a CEEC under the BC Act)	93	Low	27.6	101	1.52
1800_medium	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.	Forested Wetlands	Coastal Floodplain Wetlands	Yes - aligns to the EEC Swamp Oak Floodplain Forest (BC Act)	60	Medium	36.1	101	0.47

¹ Alignment to NSW and Commonwealth TECs have been provided in Table 3-3 to Table 3-7

Vegetation Zone	Plant community type (PCT)	Vegetation Formation	Vegetation Class	Threatened Ecological Community ¹	PCT Cleared Extent	Condition identified (Used in BAM-C)	Vegetation integrity score	Patch size (ha)	Area (ha) within vegetation clearance boundary
Non-native	Non-native	-	-	-	-	-	-	-	35.46
Total									44.85

Table 3-3 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) in moderate condition

PCT 849 _Moderate	
Vegetation formation	Grassy Woodlands
Vegetation class	Coastal Valley Grassy Woodlands
Conservation status	Aligns to Cumberland Plain Woodland in the Sydney Basin Bioregion listed as a Critically Endangered Ecological Community under the BC Act and EPBC Act.
% cleared	93
Characteristics of the PCT	DPIE (2021d) characterises PCT 849 as having a gentle topography associated with the shale plains of western Sydney and carries an open grassy woodland dominated by <i>Eucalyptus moluccana</i> (Grey Box), <i>Eucalyptus tereticornis</i> (Forest Red Gum) and Ironbark species such as <i>Eucalyptus crebra</i> or <i>Eucalyptus fibrosa</i> . It is typified by a sparse to moderate cover of shrubs and a high cover of grasses and forbs. Tozer <i>et al.</i> (2010) define the primary habitat for the community as occurring at elevations less than 150 meters above sea level with some sites occurring at higher elevations where the landscape remains gently inclined.
Extent in the assessment area (ha)	3.63 hectares
Condition	The vegetation in this zone is in a moderate condition. The canopy is well established with mature (dbh >80cm) <i>Eucalyptus moluccana</i> (Grey Box) and <i>E. tereticornis</i> (Forest Red Gum) present as well as saplings (signs of regeneration) of these species. A shrub layer predominantly comprised of <i>Bursaria spinosa</i> (Native Blackthorn) and a diverse ground cover of grasses and forbs present throughout the vegetation zone. Exotic species are present in a low to moderate abundance throughout the vegetation zone and include species such as, <i>Eragrostis curvula</i> (African Lovegrass) in the understorey and <i>Olea europaea</i> subsp. <i>cuspidata</i> (African Olive) in the midstorey.
Plots completed	Two (Plots 4 and 5)
Composition condition score	23.6
Structure condition score	64.5
Function condition score	75.4
Vegetation integrity score	48.6

Composition

Trees: 3
Shrubs: 0.5
Grass and grass like: 2.5
Forb: 5.5
Fern: 0
Other:1.5



Photo 1. BAM plot 4

Photo



Photo 2. BAM plot 5

Justification	<p>As mentioned above, diagnostic canopy species of PCT 849 include <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>Eucalyptus moluccana</i> (Grey Gum), both of which were observed throughout this vegetation zone. Most of the observed trees were around 30 dbh, however, mature (>80 dbh) and juvenile (<5 dbh) trees were also observed and recorded in this vegetation zone.</p> <p>The midstorey ranged from a sparse to dense cover of <i>Bursaria spinosa</i> (Blackthorn) which is a diagnostic species of Cumberland Plain Woodland.</p> <p>Plots sampled confirm the presence of groundcover species diagnostic of PCT 849, including <i>Microlaena stipoides</i> (Weeping Grass) and <i>Bothriochloa macra</i> (Redlegs Grass) and <i>Sporobolus creber</i> (slender Rat's Tail Grass). Forb species include <i>Dichondra repens</i> (Kidney Weed), <i>Wahlenbergia gracilis</i> (Australian Bluebell), <i>Glycine microphylla</i> (Small-leaf Glycine) and <i>Asperula conferta</i> (Common Woodruff).</p> <p>A full species list for all surveyed plots is found in Annexure A and the extent of vegetation within the proposal area is shown in Figure 5. The native vegetation and other diagnostic features within these areas conformed with NSW State and the Commonwealth description for the TEC (as explained below).</p>
How it meets the BC Act Determination	<p>PCT 849_ Moderate meets the BC Act listing of the CEEC Cumberland Plain Woodland based on the following characteristics (DPIE 2021g):</p> <ul style="list-style-type: none"> • The vegetation zone is characterised by the presence of <i>Eucalyptus tereticornis</i> (Red Gum) and <i>E. moluccana</i> (Grey Gum). • A shrub layer dominated by <i>Bursaria spinosa</i> (Blackthorn) is present. • The understorey is characterised by a high abundance of native grasses and a high diversity of forbs. • Characteristic species are present as identified in the Scientific Determination • Occurs within the known range of the TEC.
How it meets the EPBC Act Determination	<p>PCT 849_ Moderate meets the EPBC Act listing of the CEEC Cumberland Plain Woodland based on the following characteristics (DAWE 2010):</p> <ul style="list-style-type: none"> • Native tree species present with a minimum projected foliage cover of 10%. • The patch of the ecological community is 0.5 ha or greater in size. • Of the perennial understorey vegetative cover present, 50% is made up of native species.

Table 3-4 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) Low condition

PCT 849_Low	
Vegetation formation	Grassy Woodlands
Vegetation class	Coastal Valley Grassy Woodlands
Conservation status	Aligns to Cumberland Plain Woodland in the Sydney Basin Bioregion listed as a Critically Endangered Ecological Community under the BC Act.
% cleared	93
Characteristics of the PCT	DPIE (2021d) characterises PCT 849 as having a gentle topography associated with the shale plains of western Sydney and carries an open grassy woodland dominated by <i>Eucalyptus moluccana</i> (Grey Box), <i>Eucalyptus tereticornis</i> (Forest Red Gum) and Ironbark species such as <i>Eucalyptus crebra</i> (Small-leaved Ironbark) or <i>Eucalyptus fibrosa</i> (Broad-leaved Ironbark). It is typified by a sparse to moderate cover of shrubs and a high cover of grasses and forbs. Tozer et al. (2010) define the primary habitat for the community as occurring at elevations less than 150 meters above sea level with some sites occurring at higher elevations where the landscape remains gently inclined.
Extent in the assessment area (ha)	0.92 hectares
Condition	<p>The condition of this vegetation zone is low, there were no mature canopy species within this vegetation condition, however there was evidence of regeneration. The midstorey is scattered and regenerating, but where present comprises <i>Bursaria spinosa</i> (Native Blackthorn). Native ground cover is present in the zone, however it is typically suppressed by exotic species.</p> <p>Weed cover is high throughout the zone, and is typically dominated by <i>Eragrostis curvula</i> (African Lovegrass) in the understorey and <i>Olea europaea subsp. cuspidata</i> (African Olive) in the midstorey.</p>
Plots completed	1 (Plot 7)
Composition condition score	17.5
Structure condition score	9.1
Function condition score	2.8
Vegetation integrity score	7.6

Composition	Trees: 2
	Shrubs: 2
	Grass and grass like: 3
	Forb: 3
	Fern: 9
	Other: 2

Photo



Photo 3. BAM plot 7

Justification

As mentioned above, diagnostic canopy species of PCT 849 include *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus moluccana* (Grey Box), both of which were observed to be regenerating in this vegetation zone. Additionally, the moderate condition vegetation surrounding the Low condition vegetation was identified as PCT 849.

A regenerating midstorey of *Bursaria spinosa* (Blackthorn), which is a diagnostic species of PCT 849, was observed and recorded in this vegetation zone.

Plots sampled confirm the presence of groundcover species diagnostic of PCT 849 including *Themeda australis* (Kangaroo Grass), *Brunoniella australis* (Blue Trumpet), *Glycine tabacina* and *Centella asiatica* (Indian Pennywort).

A full species list for all surveyed plots is found in Annexure A and the extent of vegetation within the proposal is shown in Figure 5. The native vegetation and other diagnostic features within these areas conformed with NSW State description for the TEC (as explained below).

How it meets the BC Act Determination

PCT 849_Low meets the BC Act listing of the CEEC Cumberland Plain Woodland based on the following characteristics (DPIE 2021g):

- Characterised by the presence of regenerating *Eucalyptus tereticornis* (Red Gum) and *E. moluccana* (Grey Box) species
- A sparse shrub layer dominated by *Bursaria spinosa* (Blackthorn) is present.
- The understorey is characterised by native grasses and a moderate diversity of forbs
- Characteristic species are present as identified in the Scientific Determination
- Occurs within the known range of the TEC.

PCT 849_Low

How it meets the EPBC Act Determination

PCT 849_Low does not meet the EPBC Act Determination criteria for the CEEC Cumberland Plain Woodland due to the zone not meeting the first condition threshold:

- Native tree species are not present at the minimum projected foliage cover of 10%.

As the zone does not meet the first condition threshold it is automatically not considered the listed ecological community (DAWE 2010).

Table 3-5 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835) moderate condition

PCT 835_Moderate

Vegetation formation	Forested Wetlands
Vegetation class	Coastal Floodplain Wetlands
Conservation status	Aligns to River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC under the BC Act and as a CEEC under EPBC Acts.
% cleared	93
Characteristics of the PCT	DPIE (2021d) characterises PCT 835 as an open eucalypt forest situated on broad alluvial flats of the Hawkesbury and Nepean river systems. It also forms narrower ribbons alongside streams and creeks that drain the Cumberland Plain. Typically, the canopy includes one of either <i>Angophora floribunda</i> (Rough-barked Apple) or <i>Angophora subvelutina</i> (Broad-leaved Apple) and one or both of <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>Eucalyptus amplifolia</i> (Cabbage Gum). The ground layer is characterised by an abundant cover of grasses with small herbs and ferns. Cumberland Riverflat Forest occurs at altitudes between one and 160 metres above sea level and with a mean annual rainfall of 750-1000 millimetres.
Extent in the assessment area (ha)	2.84 hectares
Condition	The vegetation in this zone is in a moderate condition. The canopy is well established with mature (dbh >80cm) <i>E. tereticornis</i> (Red Gum) and <i>Angophora floribunda</i> (Rough-barked Apple) present, a shrub layer predominantly comprised of <i>Bursaria spinosa</i> (Native Blackthorn), and a diverse ground cover of grasses and forbs. Exotic species are present in a moderate to low abundance throughout the vegetation zone and include, <i>Bidens pilosa</i> (Cobbler's Pegs), <i>Verbena bonariensis</i> (Purpletop), <i>Olea europaea subsp. cuspidata</i> (African Olive) and <i>Ligustrum sinensis</i> (Small-leaf Privet) in the midstorey.
Plots completed	2 (Plots 3 and 6)
Composition condition score	58.9
Structure condition score	81.3

PCT 835_Moderate

Function
condition score 79.4

Vegetation
integrity score 72.4

Composition
Trees: 2.5
Shrubs: 1.5
Grass and grass like: 4.5
Forb: 5.5
Fern: 0
Other:2.5

Photo



Photo 4. BAM plot 3



Photo 5. BAM plot 6

<p>Justification</p>	<p>As mentioned above, diagnostic canopy species of PCT 835 include <i>Angophora floribunda</i> (Rough-barked Apple) and <i>Eucalyptus tereticornis</i> (Forest Red Gum), both of which were observed throughout this vegetation zone. Most of the observed trees were around 30 dbh, however, mature (>80 dbh) and juvenile (<5 dbh) trees were also observed and recorded in this vegetation zone.</p> <p>The midstorey had a spare cover of <i>Bursaria spinosa</i> (Blackthorn) which is a diagnostic species of PCT 835.</p> <p>Plots sampled confirm the presence of groundcover species diagnostic of PCT 835 including <i>Microlaena stipoides</i> (Weeping Grass), <i>Dichondra repens</i> (Kidney Weed), <i>Clematis aristata</i> (Old Mans Beard), <i>Oplismenus aemulus</i> (Basket Grass), <i>Wahlenbergia gracilis</i> (Australian Bluebell), <i>Glycine microphylla</i> (Small-leaf Glycine) and <i>Geranium solanderi</i> (Native Geranium).</p> <p>A full species list for all surveyed plots is found in Annexure A and the extent of vegetation within the proposal is shown in Figure 5. The native vegetation and other diagnostic features within these areas conformed with NSW State and the Commonwealth description for the TEC (as explained below).</p>
<p>How it meets the BC Act Determination</p>	<p>PCT 835_ Moderate meets the BC Act listing of the CEEC River-flat Eucalypt Forest based on the following characteristics (DPIE 2021g):</p> <ul style="list-style-type: none"> • Characterised by the presence of <i>Eucalyptus tereticornis</i>, <i>Angophora floribunda</i> and <i>Casuarina glauca</i> • A shrub layer dominated by <i>Bursaria spinosa</i> is present. • The understorey is characterised by a high abundance of native grasses and a high diversity of forbs • Characteristic species are present as identified in the Scientific Determination • Occurs within the known range of the TEC.
<p>How it meets the EPBC Act Determination</p>	<p>PCT 835_ Moderate meets the EPBC Act listing of the CEEC River-flat Eucalypt Forest based on the following characteristics:</p> <ul style="list-style-type: none"> • 30% of its total understorey vegetation cover is comprised of native species (exotic annuals are excluded from this assessment) • Ground cover richness \geq 4 native species per 0.04 ha sample plot • Small contiguous patch size \geq 0.5 ha within a patch of native vegetation \geq 5 ha <p>Based on PCT 835_ Moderate meeting the above condition thresholds it meets the Category C2 'Large or contiguous patch in moderate condition' (DoEE 2021).</p>

Table 3-6 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835) low condition

PCT 835_Low	
Vegetation formation	Forested Wetlands
Vegetation class	Coastal Floodplain Wetlands
Conservation status	Aligns to River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC under the BC Act.
% cleared	93
Characteristics of the PCT	DPIE (2021d) characterises PCT 835 as an open eucalypt forest situated on broad alluvial flats of the Hawkesbury and Nepean river systems. It also forms narrower ribbons alongside streams and creeks that drain the Cumberland Plain. Typically, the canopy includes one of either <i>Angophora floribunda</i> (Rough-barked Apple) or <i>Angophora subvelutina</i> (Broad-leaved Apple) and one or both of <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>Eucalyptus amplifolia</i> (Cabbage Gum). The ground layer is characterised by an abundant cover of grasses with small herbs and ferns. Cumberland Riverflat Forest occurs at altitudes between one and 160 metres above sea level and with a mean annual rainfall of 750-1000 millimetres.
Extent in the assessment area (ha)	1.52 hectares
Condition	The vegetation in this zone is in a low condition. There are no mature canopy species, however young trees and canopy regeneration was observed. The shrub layer is sparse, but where present include diagnostic species such as <i>Acacia parramattensis</i> (Parramatta wattle) and <i>Bursaria spinosa</i> (Native Blackthorn). There is low to moderate species diversity due to suppression by exotic species in the midstorey and understorey. Exotic species are present high abundance throughout the vegetation zone, with the most abundant species being <i>Eragrostis curvula</i> (African Lovegrass) and <i>Chloris gayana</i> (Rhodes Grass), other species include <i>Bidens pilosa</i> (Cobbler's Pegs), <i>Verbena bonariensis</i> (Purpletop), <i>Olea europaea</i> subsp. <i>cuspidata</i> (African Olive) and <i>Ligustrum sinensis</i> (Small-leaf Privet) in the midstorey.
Plots completed	3 (Plots 1, 2 and 9)
Composition condition score	33.9
Structure condition score	16
Function condition score	38.7
Vegetation integrity score	27.6

Composition

Trees: 1.7
Shrubs: 2.3
Grass and grass like: 3.3
Forb: 3
Fern: 0
Other:1

Photoa



Photo 6. BAM plot 1



Photo 7. BAM plot 2



Photo 8. BAM plot 9

Justification

As mentioned above, diagnostic canopy species of PCT 835 include *Eucalyptus tereticornis* (Forest Red Gum), *Angophora floribunda* (Rough-barked Apple) and *Casuarina glauca* (Swamp Oak), which were all recorded regenerating in this vegetation zone.

The shrub layer in this vegetation zone is sparse, but where present, include species such as *Acacia parramattensis* (Parramatta wattle) and *Bursaria spinosa* (Native Blackthorn), both of which are diagnostic species of PCT 835.

Plots sampled confirm the presence of groundcover species diagnostic of PCT 835, including *Microlaena stipoides* (Weeping Grass), *Dichondra repens* (Kidney Weed), *Clematis aristata* (Old Mans Beard), and *Glycine microphylla* (Small-leaf Glycine).

A full species list for all surveyed plots is found in Annexure A and the extent of vegetation within the proposal is shown in Figure 5. The native vegetation and other diagnostic features within these areas conformed with NSW State description for the TEC (as explained below).

How it meets the BC Act Determination

PCT 835_Low meets the BC Act listing of the CEEC River-flat Eucalypt Forest based on the following characteristics (DPIE 2021g):

- Characterised by the presence of *Eucalyptus tereticornis*, *Angophora floribunda* and *Casuarina glauca*
- The understorey in intact areas is characterised by native grasses and a moderate diversity of forbs
- Characteristic species are present as identified in the Scientific Determination
- Occurs within the known range of the TEC.

How it meets the EPBC Act Determination

PCT 835_Low does not meet the EPBC Act Determination criteria for the CEEC River-flat Eucalypt Forest due to the zone not meeting the condition thresholds for a small patch (≥ 0.5 ha) which are:

- 30% of its total understorey vegetation cover is comprised of native species (exotic annuals are excluded from this assessment)
- Ground cover richness ≥ 4 native species per 0.04 ha sample plot

As the zone does not meet the above condition thresholds it is not considered the listed ecological community (DoEE 2021).

Table 3-7 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (PCT 1800) in moderate condition

PCT 1800_Low	
Vegetation formation	Forested Wetlands
Vegetation class	Coastal Floodplain Wetlands
Conservation status	Aligns to Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC under the BC Act.
% cleared	60
Characteristics of the PCT	DPIE (2021d) characterises PCT 1800 as being found on the riverflats of the Cumberland Plain in western Sydney and in the Hunter Valley. The distinguishing feature is the prominent stands of <i>Casuarina glauca</i> (Swamp Oak) found along or near streams. Often these are relatively young trees, swarming amongst a mix of old and young eucalypts such as <i>Angophora floribunda</i> (Rough-barked Apple), <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>Eucalyptus moluccana</i> (Grey Box). This community features an open grassy and herbaceous understorey, as is typical of riverflat forests.
Extent in the assessment area (ha)	0.47 hectares
Condition	<p>The condition of vegetation within the proposal area is low. <i>Casuarina glauca</i> (Swamp Oak) dominates this vegetation zone and was observed regenerating. Midstorey was sparse in the vegetation zone, however <i>Cupaniopsis anacardioides</i> (Tuckeroo) was observed regenerating.</p> <p>Native understorey species abundance and diversity is low, where present species include <i>Microlaena stipoides</i> (Weeping Grass), <i>Dichondra repens</i> (Kidney Weed) and <i>Lobelia purpurascens</i> (White Root).</p> <p>Weed cover in this vegetation zone is moderate, with the cover increasing closer to the waterway and road. The most common exotic species include <i>Rubus fruticosus</i> (Blackberry) and <i>Cestrum parqui</i> (Green Cestrum).</p>
Plots completed	1 (Plot 8)
Composition condition score	32.7
Structure condition score	19.3
Function condition score	74.6
Vegetation integrity score	36.1

PCT 1800_Low

Composition	Trees: 1 Shrubs: 0 Grass and grass like: 3 Forb: 5 Fern: 0 Other:1
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Photo



Photo 9. BAM plot 8

Justification	As mentioned above, the diagnostic canopy species of PCT 1800 is <i>Casuarina glauca</i> (Swamp Oak) which was observed as the only canopy species in this vegetation zone. Native midstorey was absent in the plot, however <i>Cupaniopsis anacardioides</i> (Tuckeroo) was observed regenerating within the vegetation zone, and is considered to be a diagnostic species of PCT 1800. Plots sampled confirm the presence of groundcover species diagnostic of PCT 1800 including <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Oplismenus imbecillis</i> (Creeping Beard Grass).
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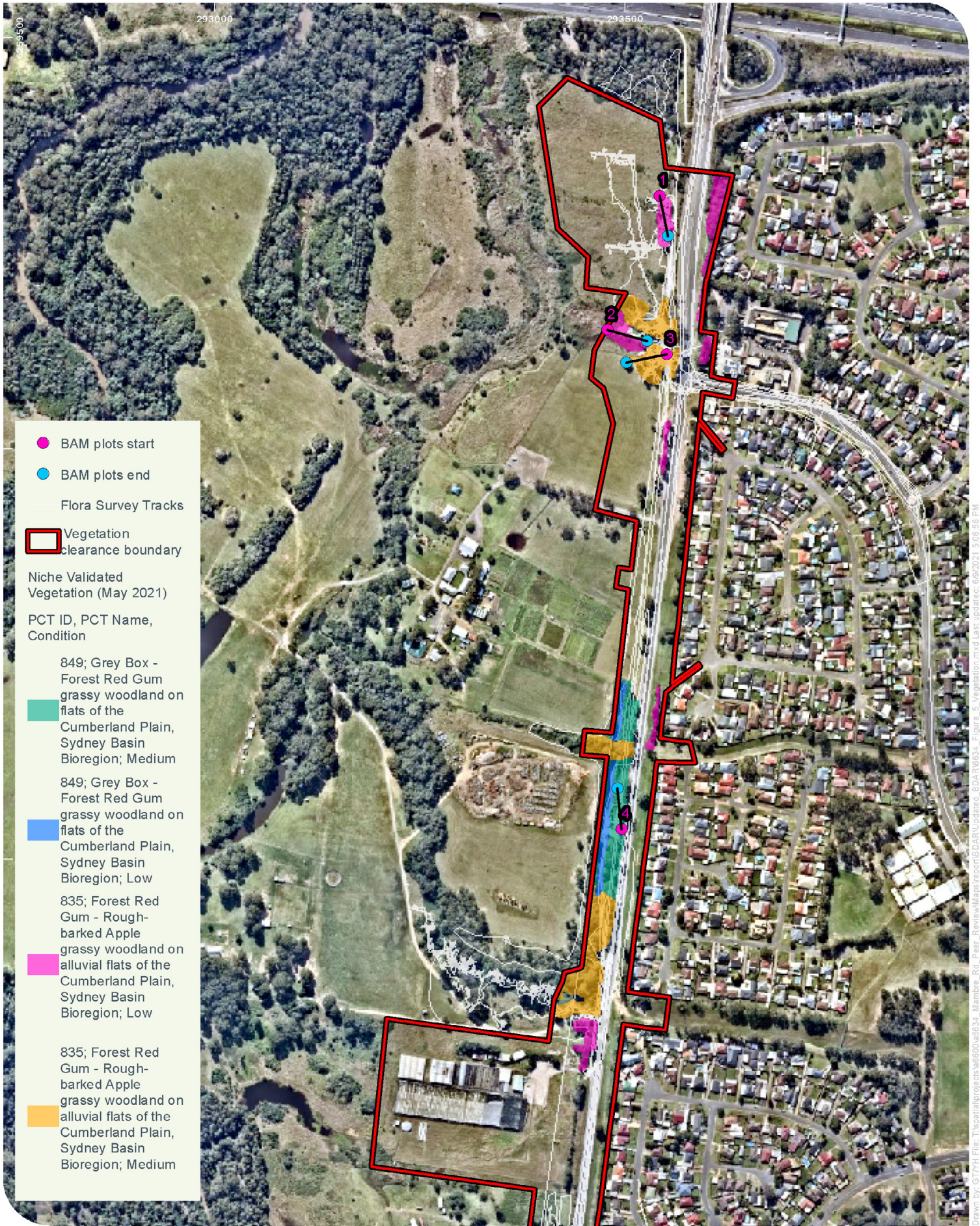
How it meets the BC Act Determination	PCT 1800_Low meets the BC Act listing of the CEEC Swamp Oak Floodplain Forest based on the following characteristics (DPIE 2021g): <ul style="list-style-type: none">• Characterised by <i>Casuarina glauca</i> dominating the canopy• Characteristic species are present as identified in the Scientific Determination.• Vegetation zone appeared to be waterlogged and was situated along a drainage line in the south of the site.• Occurs within the known range of the TEC.
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How it meets the EPBC Act Determination	PCT 1800_Low is a small contiguous patch (0.5 ha - 2 ha, and is connected to a larger area of native vegetation of at least 5 ha). However, this patch does not meet the condition thresholds which for a small contiguous patch include: <ul style="list-style-type: none">• Mostly native understorey Non-native species comprise less than 50% of total understorey vegetation cover• AND transformer species comprise less than 30% of total understorey vegetation cover As PCT 1800_Low does not meet the above EPBC Act Determination criteria it is not considered the listed EEC Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest (DoEE 2018).
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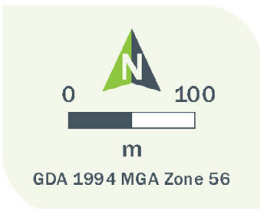
3.3 Weeds

The weed species commonly found across the proposal area included: *Bidens pilosa* (Cobblers pegs), *Taraxacum officinale* (Dandelion), *Sonchus oleraceus* (Common Sowthistle), *Lysimachia arvensis* (Scarlet Pimpernel), *Eragrostis curvula* (African lovegrass), and *Senecio madagascariensis* (Fire weed).

Weeds that were recorded throughout the BAM plot collected that are regarded as 'High Threat Weeds', include the following: *Ligustrum sinense* (Small-leaved privet), *Rubus fruticosus* sp. agg. (Blackberry), *Asparagus asparagoides* (Asparagus fern), *Olea europaea* subsp. *cuspidate* (African olive), *Bidens pilosa* (Cobblers pegs), *Cyperus eragrostis*, *Cestrum parqui* (Cestrum), *Paspalum dilatatum* (Paspalum), *Ehrharta erecta* (Ehrharta), *Ageratina adenophora* (Crofton weed), and *Cardiospermum grandiflorum* (Balloon vine).



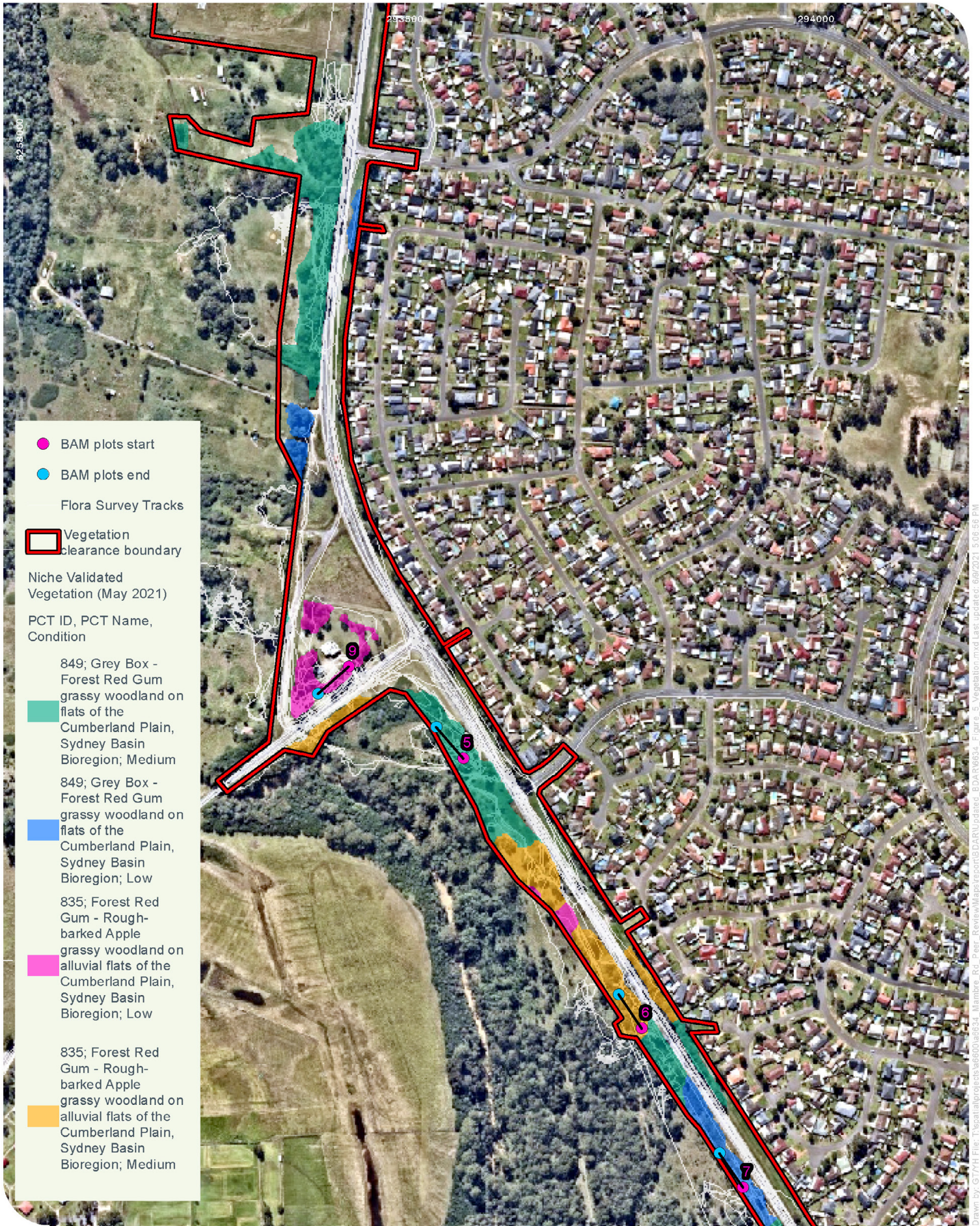
Drawn by: G7YH File: T:\spatial\projects\6600\ae634_Mamre_Rd_Per_Review\Map\report\BDAR\Updated_BDAR\6634_Figure_5_Vegetation.mxd Last updated: 6/9/2021 5:08:56 PM

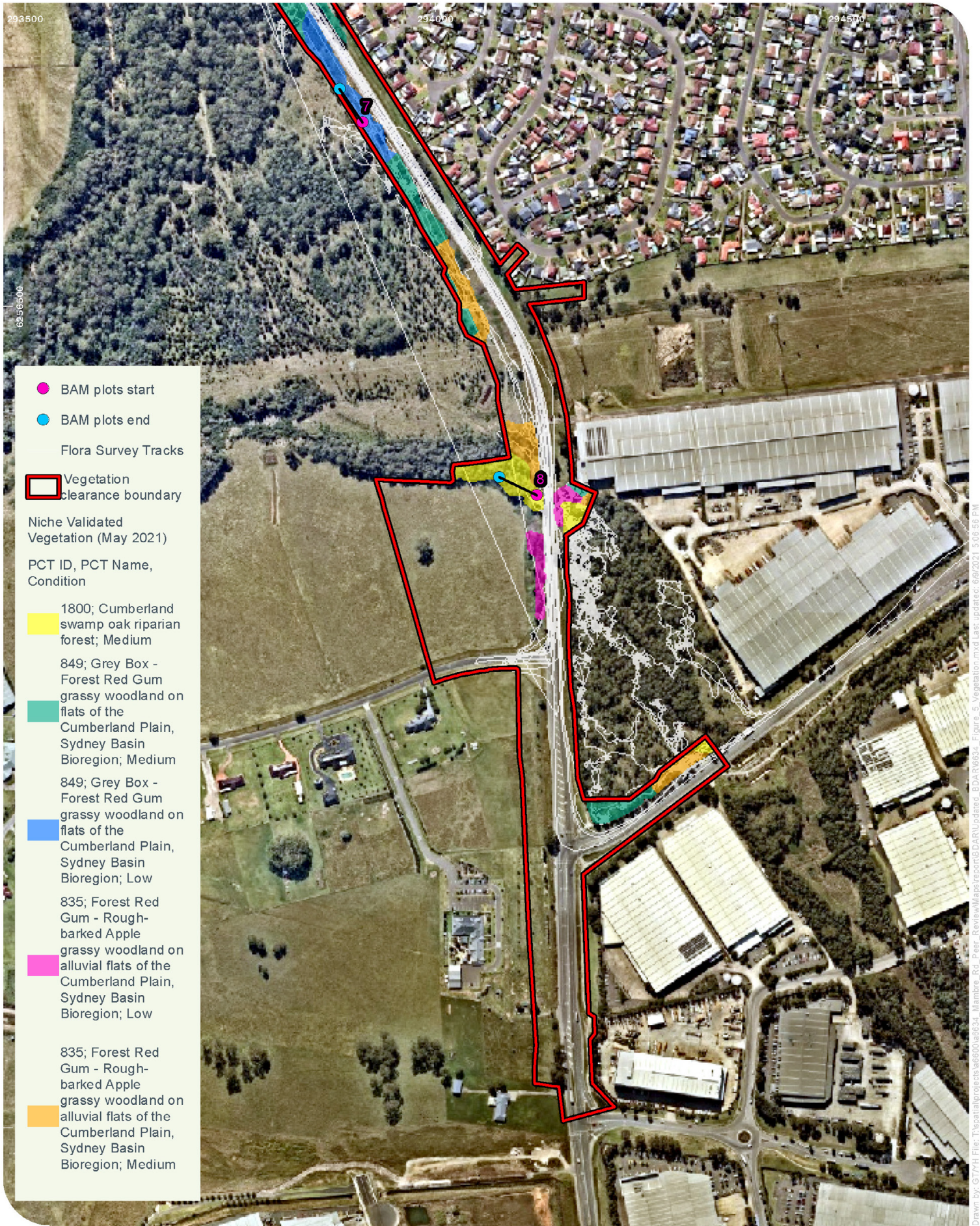


Validated Vegetation mapping
Mamre Road Upgrade – Stage 1
Biodiversity Development Assessment Report (BDAR)

Niche PM: Luke Baker
Niche Proj. #: 6634
Client: Transport for NSW / Aurecon

Figure 5.1





3.4 Threatened ecological communities

A list of TECs occurring or potentially occurring within 10 km of the proposal area as generated from the database searches is detailed in section 3.1 and Annexure A. The database searches identified seven TECs that have been identified as potentially occurring within the locality.

Based on the results of the detailed vegetation validation, and review of the listing advice and descriptions of the TECs, it has been determined that three of the PCTs recorded within the proposal area met the descriptions of TECs under the BC Act and/or EPBC Act (Table 3-2) (Figure 6). A description associated with the alignment to each TEC is provided below:

3.4.1 Cumberland Plain Woodland in the Sydney Basin Bioregion

PCT 849 identified within the proposal area corresponds with the TEC Cumberland Plain Woodland in the Sydney Basin Bioregion. This TEC has been listed as a Critically Endangered Ecological Community (CEEC) in Part 1 of Schedule 2 of the BC Act, and is also listed as a CEEC under the EPBC Act.

As discussed in Table 3-3, the alignment of the PCT 849 to the BC Act listing of Cumberland Plain Woodland CEEC is supported by the following:

- The structure of the vegetation within the proposal area that correlate with PCT 849 is of a grassy woodland, comprising of key diagnostic species of the CEEC, including *Eucalyptus molucanna* and *E. tereticornis*
- A shrub layer dominated by *Bursaria spinosa* is present which is typical of the TEC
- Characteristic understorey species is present
- Occurs within the known range of the TEC.

A total of 4.55 hectares of the BC Act listed Cumberland Plain Woodland occurs at the site.

In regards to the Commonwealth listing, a total of 3.63 hectares the EPBC Act listed Cumberland Plain Woodland occurs at the proposal area. This is made up of the moderate condition class of PCT 849 which aligns with the definition of Cumberland Plain Woodland as per the EPBC Act listing based on the following characteristics (DEWHA 2009):

- Native tree species present with a minimum projected foliage cover of 10 percent
- The patch of the ecological community is 0.5 hectares or greater in size
- Of the perennial understorey vegetative cover present, 50 percent is made up of native species.

The low condition class of PCT 849 does not meet the Commonwealth listing given native tree species are not present at the minimum projected foliage cover of 10 percent.

3.4.2 River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

PCT 835 identified within the proposal area corresponds with the TEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This TEC is listed in Schedule 2, Part 2 of the BC Act as an EEC.

As discussed in Table 3-5, the alignment of 4.36 hectares of PCT 835 to the BC Act listing River-Flat Eucalypt Forest EEC is supported by the following:

- Characterised by the presence of *Eucalyptus tereticornis*, *Angophora floribunda* and *Casuarina glauca*
- The understorey in intact areas is characterised by native grasses and a moderate diversity of forbs
- Characteristic species are present as identified in the Scientific Determination
- Occurs within the known range of the TEC.

In regards to the Commonwealth listing, a total of 2.84 hectares the EPBC Act listed River-Flat Eucalypt Forest occurs at the site. This is made up of the moderate condition class of PCT 835 which meets the Commonwealth definition due to the following:

- 30 percent of its total understorey vegetation cover is comprised of native species (exotic annuals are excluded from this assessment)
- Ground cover richness ≥ 4 native species per 0.04 hectare sample plot
- Small contiguous patch size ≥ 0.5 hectare within a patch of native vegetation ≥ 5 hectare
- Based on PCT 835 Moderate meeting the above condition thresholds it meets the Category C2 'Large or contiguous patch in moderate condition' (DoEE 2021).

The low condition class of PCT 835 does not meet the EPBC Act Determination criteria for the CEEC River-flat Eucalypt Forest due to the zone not meeting the condition thresholds for a small patch (≥ 0.5 hectares) which are:

- 30 percent of its total understorey vegetation cover is comprised of native species (exotic annuals are excluded from this assessment)
- Ground cover richness ≥ 4 native species per 0.04 hectare sample plot.

3.4.3 Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

PCT 1800 within the proposal area corresponds with the TEC Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, which is listed as an EEC under the BC Act.

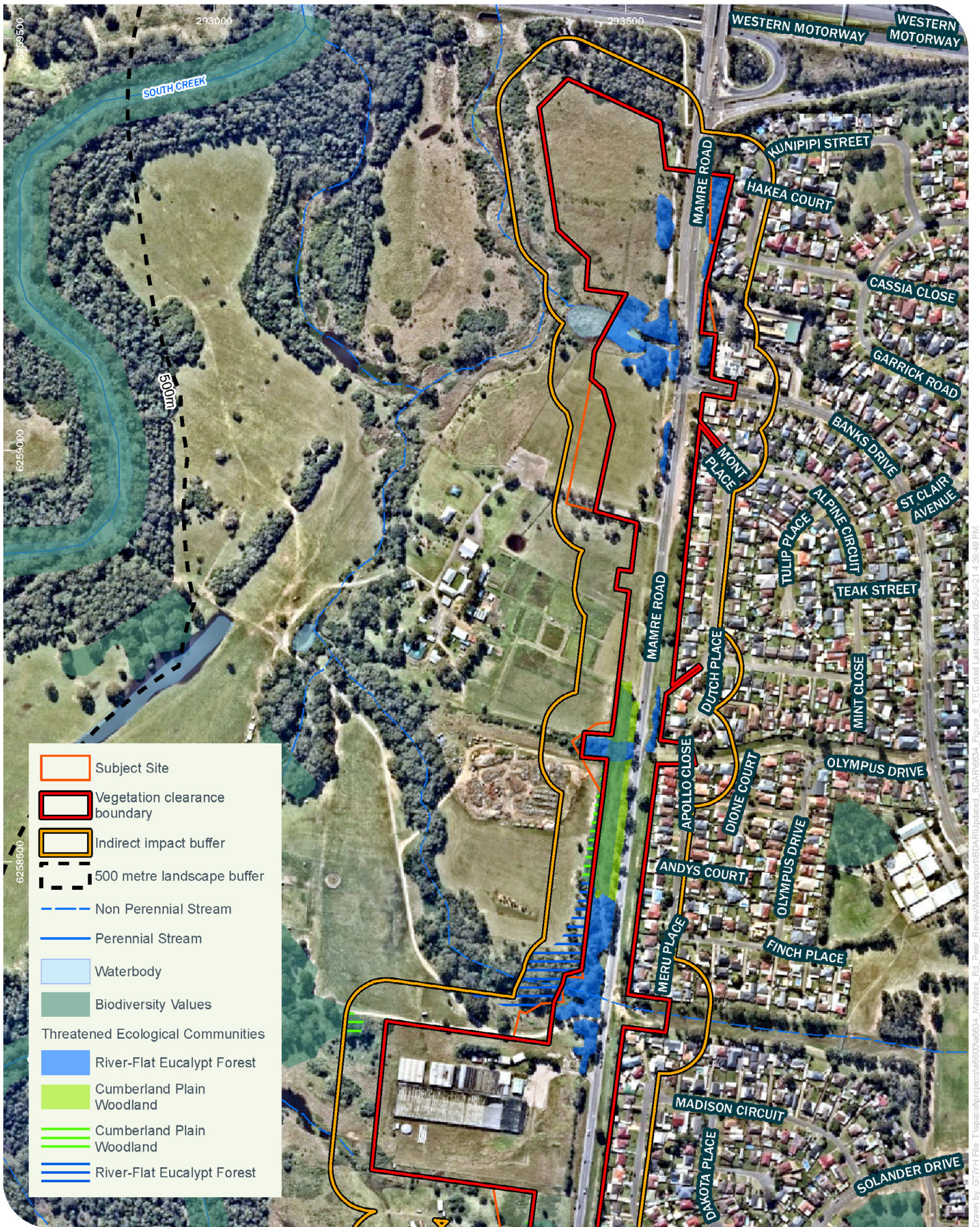
As discussed in Table 3-7, the alignment of the PCT 1800 to the BC Act listing Swamp Oak Floodplain Forest EEC is supported by the following:

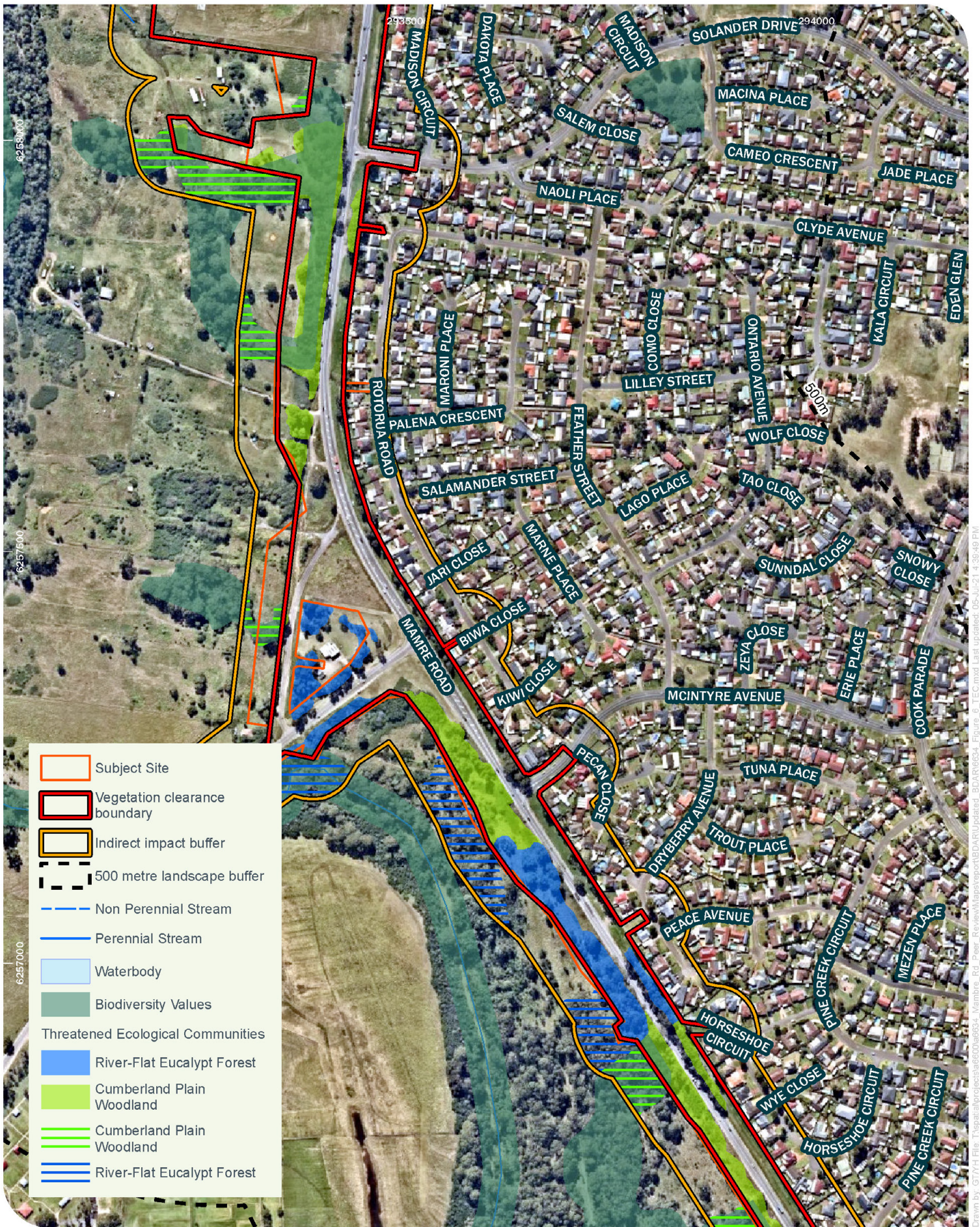
- This TEC is associated with grey-black clay-loams and sandy loams, saline groundwater, and found on waterlogged or periodically inundated flats, drainage lines and edges of other water bodies as is common for coastal floodplains. The proposal area contains clay loams on the edge of riparian areas within floodplains
- Characterised by *Casuarina glauca* dominating the canopy
- Characteristic species are present as identified in the Scientific Determination.
- Vegetation zone appeared to be waterlogged and was situated along a drainage line in the south of the site
- Occurs within the known range of the TEC.













In regards to the Commonwealth listing, the vegetation within the subject does not meet the Commonwealth definition.

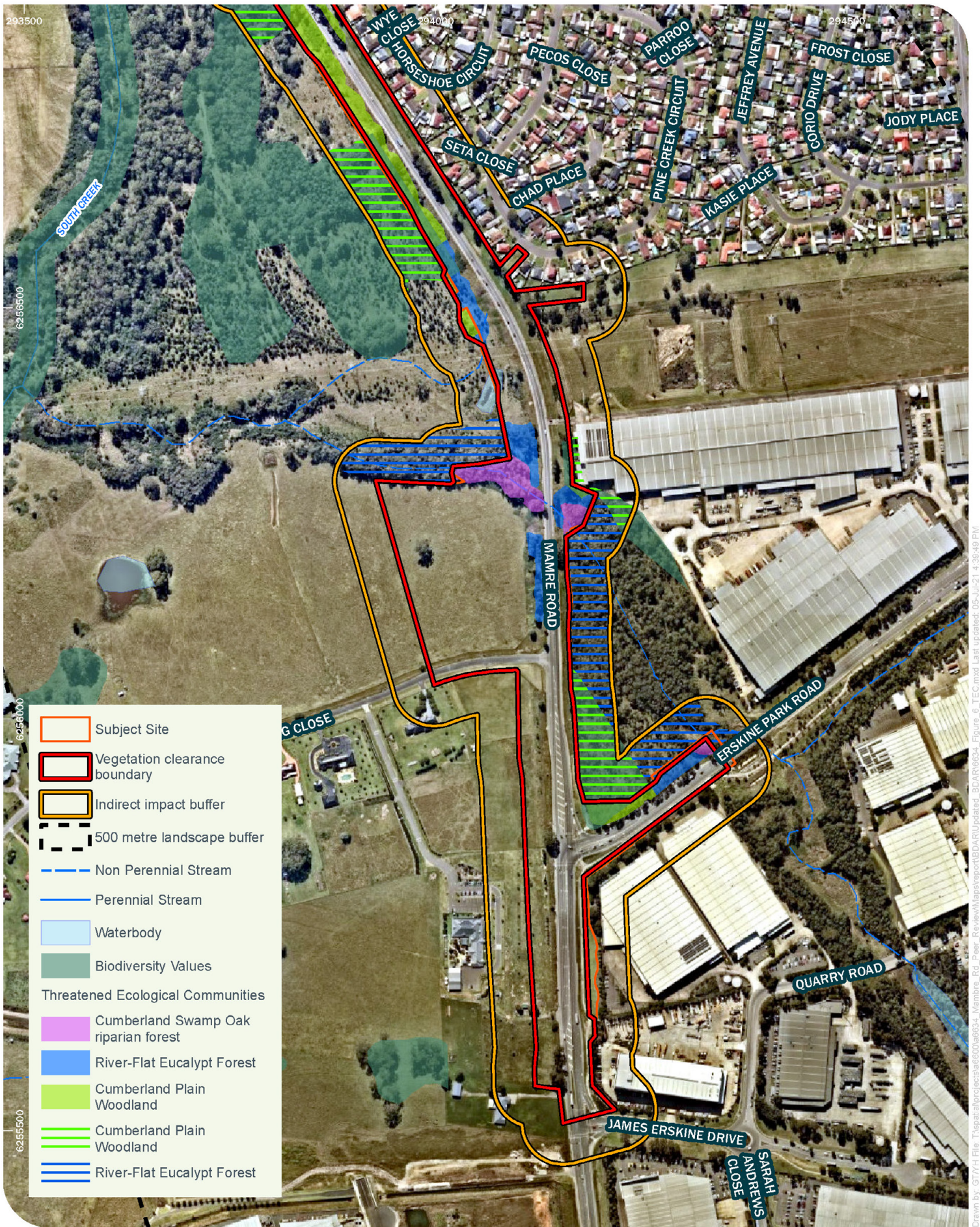
3.5 Groundwater dependent ecosystems

Groundwater dependant ecosystems (GDEs) have been discussed in the Water Quality and soil impact assessment for the proposal (Aurecon 2021). The assessment concludes that South Creek is classified as high potential aquatic GDE. The terrestrial GDEs that occur adjacent to South Creek within the proposal area are classified as high potential GDEs (DPIE 2020f). This includes the PCTs: PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, and PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.





-  Subject Site
-  Vegetation clearance boundary
-  Indirect impact buffer
-  500 metre landscape buffer
-  Non Perennial Stream
-  Perennial Stream
-  Waterbody
-  Biodiversity Values
- Threatened Ecological Communities**
-  River-Flat Eucalypt Forest
-  Cumberland Plain Woodland
-  Cumberland Plain Woodland
-  River-Flat Eucalypt Forest



- Subject Site
- Vegetation clearance boundary
- Indirect impact buffer
- 500 metre landscape buffer
- Non Perennial Stream
- Perennial Stream
- Waterbody
- Biodiversity Values
- Threatened Ecological Communities**
- Cumberland Swamp Oak riparian forest
- River-Flat Eucalypt Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland
- River-Flat Eucalypt Forest

4 Threatened species

4.1 Threatened flora

4.1.1 Background research

Relevant databases were reviewed prior to field survey to identify data gaps and inform survey design. A 10 kilometre radius was placed around the proposal area (referred to as the locality) to inform a database search area. The database search is used to identify threatened biodiversity and migratory species that may occur within the proposed area, and the locality. The following databases were used for this purpose:

- Department of Planning, Infrastructure and the Environment (DPIE) BioNet, Atlas of NSW Wildlife (DPIE 2019b)
- Department of Agriculture, Water and Environment (DAWE) EPBC Act Protected Matters Search Tool Report (DAWE 2019a)
- Threatened Species Collection Database (DPIE 2021)
- BAM-C outputs.

The result of the database searches and the BAM-C was used to determine flora species to target during field surveys (Annexure A).

4.1.2 Terrestrial flora survey methodology

A total of 39 threatened flora species with the potential to occur or have habitat within the locality are presented in Annexure 1. These species were identified based on the database searches or as generated by the BAM-C.

In total, about 60 hours of threatened flora survey was conducted across the site (Table 4-1). The landscape was relatively open resulting in limited observer obstruction during the transect walks.

Table 4-1. Threatened flora timing and effort

Dates of survey	Ecologist	Estimate of total hours of survey completed
16 to 18 September 2020	Sarah Glauert (BAM Accredited Assessor BAAS17097) Janelle So	24 hours
22 February; 26 February 2021	Paul Gadsby (BAM Accredited Assessor BAAS20010), Janelle So, Liam Stephen	32 hours
30 March 2021	Paul Gadsby (BAM Accredited Assessor BAAS20010), Janelle So,	10 hours
14 April 2021	Luke Baker (BAM Accredited Assessor BAAS17033) Yogesh Nair (BAM Accredited Assessor BAAS18144)	8 hours
29 April 2021 4 May 2021	Isabelle Lyons (Ecologist) Annabelle Grundy (Ecologist)	16 hours
Total		90 hours

All surveys have been conducted in accordance with the relevant guidelines highlighted in section 1.5, and the requirements specified in the Threatened Biodiversity Database Collection (TBDC)² as at April 2021.

4.1.3 Threatened flora results

The field survey entailed sufficient effort (over 90 hours of traverses) to determine the occurrence of threatened flora within the proposal area (Table 4-2) (Annexure 1).

No threatened flora species were recorded within the proposal area.

The analysis concluded that historic clearing events have changed the resilience across large portions of the site, particularly in vegetation zones PCT 849 Low condition and PCT 835 Low condition. These vegetation zones had relatively low recruitment of native species, and were relatively open in terms of native ground cover.

The dominance of introduced grasses, such as *Eragrostis curvula* (African love grass), *Chloris gayana* (Rhodes grass) and *Paspalum dilatatum* (Paspalum) across portions of the proposal area also would act as a suppressant for threatened flora to regenerate.

Furthermore, portions of the proposal area were dominated by introduced grasses which were regularly slashed or mown, would likely suppress threatened flora from occurring.

In accordance with Section 6.4 of the BAM, the list of potentially occurring threatened flora species may be further refined where:

- habitat constraints listed for the species in the TBDC are absent from the proposal area (or particular vegetation zones), or
- habitat constraints or microhabitats on which the species depends are sufficiently degraded such that the species is unlikely to use the proposal area, or
- the species is vagrant in the IBRA subregion, or
- an expert report is prepared (in accordance with Subsection 6.5.2 of the BAM) stating that the species is unlikely to be present on the proposal area.

Table 4-2 lists the candidate threatened flora species provides comment on the survey effort completed, and justifies where a species has been removed from further consideration.

² Threatened Biodiversity Data Collection: part of the BioNet database, published by the Biodiversity Conservation Division and accessible from the BioNet website at www.bionet.nsw.gov.au.

Table 4-2: Results for threatened flora requiring survey under the BAM-C

Scientific Name	BAM recommended survey month												Survey completed and justification if the threatened species needs to be considering further	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
<i>Acacia bynoeana</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Acacia pubescens</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Caladenia tessellata</i>										Y	Y			The species was not detected during targeted survey. Survey completed during recommended survey time. Furthermore the species has not been recorded in the region historically, nor has it been recorded during the extensive field surveys that have been related to the Western Sydney Growth Centres and associated Aerotropolis development.	Not considered further.
<i>Callistemon linearifolius</i>	Y	Y	Y								Y	Y	Y	The species was not detected during targeted survey. The survey was completed during the recommended survey time. The species is highly conspicuous species that is unlikely to remain undetected even if not flowering.	Not considered further.
<i>Cynanchum elegans</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Deyeuxia appressa</i>													Y	Whilst the survey was not completed during December, the likelihood for the presence of this species within the proposal area is very low. The species has not been recorded since 1942 in Sydney, and is presumed extinct. The areas of previous occupancy are not near the proposal area. Furthermore, the site does not contain 'moist' forest/woodland habitat which the species was once known to occupy. The condition of the proposal area (historically cleared with edge effects), coupled with lack of historic records and assumed extinction, is reasonable to assume it is unlikely to be present. Further impact assessment is therefore not required.	Not considered further.

Scientific Name	BAM recommended survey month												Survey completed and justification if the threatened species needs to be considering further	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
<i>Dillwynia tenuifolia</i>								Y	Y	Y				The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Eucalyptus benthamii</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Gyrostemon thesioides</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time.	Not considered further.
<i>Hibbertia</i> sp. <i>Bankstown</i>									Y	Y	Y	Y		The species was not detected during targeted survey. Survey completed during recommended survey time. Furthermore, the proposal area does not occur in Bankstown where the species is known to occupy.	Not considered further.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	Y	Y									Y	Y		The species was not detected during targeted survey. Survey was completed during recommended survey time. This species is conspicuous, and is unlikely to remain undetected during field survey. With the exception of Balloon Vine (<i>Cardiospermum grandiflorum</i>) and Moth Vine (<i>Araujia sericifera</i>), no other vines were recorded in the proposal area. It is highly unlikely that the species would be present within the proposal area.	Not considered further.
<i>Maundia triglochinos</i>	Y	Y	Y								Y	Y		The survey was not completed during the recommended survey month for <i>Maundia triglochinos</i> . Potential habitat for <i>Maundia triglochinos</i> is within PCT835 Low which occurs to the far north of the proposal area. This area holds water after periods of rain, and contains some native rushes and forbs which is typical of habitat occupied by the species. Luke Baker (Ecologist) inspected this area during the field survey on the 14 April 2021 and confirmed that the species is not present. Luke has extensive experience with <i>Maundia triglochinos</i> . Luke has designed and lead a multi-year <i>Maundia triglochinos</i> monitoring program for the Pacific Highway Upgrade (Oxley to Kemsey Bypass), and thus is	Not considered further.

Scientific Name	BAM recommended survey month												Survey completed and justification if the threatened species needs to be considering further	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
														very familiar with the species and associated habitat. During the monitoring program, the species can be detected all year, with the greatest issue with detection generally being areas inundated which prevents detection of the species is it is underwater. Given the area of potential habitat was damp and not inundated at the time of survey, this presented reasonable conditions for survey.	
<i>Persicaria elatior</i>	Y	Y	Y	Y	Y								Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Persoonia bargoensis</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Persoonia hirsuta</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Pilularia novae-hollandiae</i>											Y	Y	Y	The habitat across much of the proposal area is does not suit the requirement for this species (Shallow swamps and waterways). The only area of habitat that could be very marginally suitable is located within PCT 835 Low towards the north of the proposal area. This area did contain some native sedges and rushes, given it would periodically receive run off to the east of Mamre Road. However, whilst there is some very marginal habitat, the ground cover in this area is highly dominated by introduced species. Furthermore, species has not been recorded during the extensive field surveys in Western Sydney for the proposed airport (GHD 2016) which occurs about 10 km south and would offer better condition habitat compared to the proposal area.	Not considered further.

Scientific Name	BAM recommended survey month												Survey completed and justification if the threatened species needs to be considering further	Considered further
	J	F	M	A	M	J	J	A	S	O	N	D		
<i>Pimelea curviflora</i> <i>var. curviflora</i>	Y	Y	Y							Y	Y	Y	Survey was not completed during the recommended survey time, however the species is confined to the area between north Sydney in the south, and Maroota in the north-west which is well away from the proposal area. Furthermore, the species grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Such habitat is absent from the proposal area.	Not considered further.
<i>Pimelea spicata</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Pomaderris brunnea</i>								Y	Y	Y			The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Pterostylis saxicola</i>										Y			Survey was not completed during the recommended survey time, however the habitat types within the proposal area are not suitable. The species is known to grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils. Such features are not present, and thus highly unlikely to occur in the proposal area.	Not considered further.
<i>Pultenaea pedunculata</i>									Y	Y	Y		The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Thesium australe</i>	Y	Y									Y	Y	The species was not detected during targeted survey. Survey completed during recommended survey time.	Not considered further.

4.1.4 Threatened flora for further consideration

Our survey and analysis confirmed that no threatened flora requiring species credits were recorded within the proposal area. Threatened flora are therefore not required to be assessed further.

4.2 Threatened fauna

4.2.1 Background research

As for the native vegetation and flora assessment, a review of relevant literature, databases and existing vegetation mapping was carried out to identify vegetation (fauna habitat) and threatened fauna with the potential to occur within the proposal area. Data reviewed included:

- Department of Planning, Infrastructure and the Environment (DPIE) BioNet, Atlas of NSW Wildlife (DPIE 2019b)
- Department of the Agriculture, Water and Environment (DAWE) EPBC Act Protected Matters Search Tool Report (DoEE 2019a)
- Threatened Species Collection Database (DPIE 2021)
- BAM-C outputs.

The result of the database searches and the BAM-C were used to determine fauna species to target during field surveys (Annexure A).

4.2.2 Terrestrial fauna survey methodology

The likelihood of occurrence for threatened fauna, along with the candidate threatened fauna as per the BAM-C dictated the survey method approach. The database analysis determined the potential for 72 threatened fauna to occur, or have potential habitat within the locality.

The fauna survey was designed to detect potentially occurring threatened species and allow for an inventory of species to be compiled for the proposal area. Primarily, the field survey program was designed to target threatened fauna that are regarded as 'species credit' fauna, and those listed as threatened on the EPBC Act.

An overview of the survey dates has been provided in Table 4-3 below, with further detail provided in Table 4-4 and Figure 7.

Table 4-3. An overview of fauna field survey dates

Dates of survey	Ecologist	Key survey tasks completed during field campaign
16 to 18 September 2020	Sarah Glauert (Senior Ecologist/ Accredited Assessor BAAS17097) Janelle So (Ecologist - Aurecon)	Threatened flora survey, habitat mapping, Cumberland Plain Land Snail searches, Hollow-bearing tree mapping.
22 February 2021 26 February 2021 30 March 2021	Paul Gadsby (BAM Accredited Assessor BAAS20010), Janelle So (Ecologist), Liam Stephen (Ecologist)	Cumberland Plain Land Snail searches

Dates of survey	Ecologist	Key survey tasks completed during field campaign
22 February 2021 23 February 2021 1 March 2021 2 March 2021 9 March 2021	G. Tear (Ecologist) W. Thurston (Ecologist / BAM Accredited Assessor BAAS18019) D. Pisani (Ecologist) D. Raines (Ecologist) S. Stephenson (Field officer) A. Chapman (Ecologist)	Owl surveys, spotlighting, threatened amphibian surveys.
14 April 2021	Luke Baker (BAM Accredited Assessor) Yogesh Nair (BAM Accredited Assessor)	Vegetation mapping, threatened flora survey, habitat mapping.
29 April 2021 4 May 2021	Isabelle Lyons (Ecologist) Annabelle Grundy (Ecologist)	Vegetation mapping, threatened flora survey.
26 to the 28 April 2021	Dr Jai Green-Barber Annabelle Grundy	Cumberland Plain Land Snail Searches, SAT searches, spotlighting, stag watching, hollow-bearing tree mapping, bird survey, amphibian survey.

Table 4-4. Threatened Fauna Survey Methodology

Type	Key target species	Minimum survey requirements ¹	Survey completed
Amphibians – All amphibians	Green and Golden Bell Frog (<i>Litoria aurea</i>) And All threatened amphibians	Survey Period – November-March Survey method – Aural-visual surveys (minimum 4 days) / Acoustic recorder (minimum 14 days) / Tadpole search (minimum 2 days) (DPIE, 2020).	Nocturnal surveys including spotlighting and call playback – 22 to 23 February, 1, 2 and 9 March 2021 (7.30pm-10.30pm 9 hours) 27 to 28 April 2021 (6.30-8.30pm 4 hours)
Threatened birds – All birds	Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	Survey Period – October-January (if suitable habitat as defined in TBDC is present) (see Table 4-6) Survey method – Area searches/ transect surveys	Habitat assessment and diurnal area searches – 27 to 28 April (2.30-5.30pm 6 hours), 29 April and 4 May (8 hours).
	Eastern Osprey (<i>Pandion cristatus</i>)	Survey Period – April-November Area searches for individuals detected by sightings, calls and signs of occupancy (Commonwealth of Australia, 2004).	Diurnal survey for individuals, and large stick nests, 16 to 18 September 2020 (6 hours) 27 to 28 April (2.30-5.30pm 6 hours), 29 April and 4 May (8 hours).

Type	Key target species	Minimum survey requirements ¹	Survey completed
	White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	Survey Period – July-December (DEC, 2004b). Survey method – Area searches for individuals detected by sightings, calls and signs of occupancy (Commonwealth of Australia, 2004).	Diurnal survey for individuals, and large stick nests, 16 to 18 September 2020 (6 hours) 27 to 28 April (2.30-5.30pm 6 hours), 29 April and 4 May (8 hours).
	Little Eagle (<i>Hieraaetus morphnoides</i>)	Survey Period – August-October (DEC, 2004b). Survey method – Area searches for individuals detected by sightings, calls and signs of occupancy (Commonwealth of Australia, 2004).	Diurnal survey for individuals, and large stick nests, 16 to 18 September 2020 (6 hours) 27 to 28 April (2.30-5.30pm 6 hours), 29 April and 4 May (8 hours).
	Square-tailed Kite (<i>Lophoictinia isura</i>)	Survey Period – September-January (DEC, 2004b). Survey method – Area searches for individuals detected by sightings, calls and signs of occupancy (Commonwealth of Australia, 2004).	Diurnal survey for individuals, and large stick nests, 16 to 18 September 2020 (6 hours) 27 to 28 April (2.30-5.30pm 6 hours), 29 April and 4 May (8 hours).
	Bush Stone-curlew (<i>Burhinus grallarius</i>)/ All threatened Owl	Survey Period – All year. Survey method – Diurnal survey including search, habitat walk-through to flush, listen/Nocturnal survey including listening (dusk), spotlighting and call playback (NSW NPWS 2006)	Diurnal surveys – 27 to 28 April 2021 (2.30-5.30pm 6 hours) Nocturnal surveys including spotlighting and call playback – 27 to 28 April 2021 (6.30-8.30pm 4 hours)
	Eastern Pygmy-possum (<i>Cercartetus nanus</i>)	Survey Period – October-March Survey method – trapping/nest-boxes/camera-traps	Habitat assessment – 27 to 28 April (2.30-5.30pm 6 hours), 29 April and 4 May (10am-3pm 10 hours). Nocturnal area searches – 23 and 26 February 2021, 1, 2 and 9 March 2021 (>20 hours) 27 to 28 April 2021 (6.30-8.30pm 4 hours).
Mammals – all	Squirrel Glider (<i>Petaurus norfolcensis</i>)	Survey Period – All year. Survey method – Trapping (minimum 3 nights)/hair tubes (minimum 4 nights)call detection/call playback (minimum 2 nights)/ spotlighting (minimum 2 nights)/stag watching (minimum 30 minutes prior to sunset and 60 minutes following sunset) / next box and camera traps (minimum 14 nights) (Commonwealth of Australia, 2004; DEC 2004a).	Spotlighting, 27 to 29 April 2021 (6.30-8.30pm two nights/4 hours)

Type	Key target species	Minimum survey requirements ¹	Survey completed
	Koala (<i>Phascolarctos cinereus</i>)	Survey Period – All year. Survey method – Hair tubes (minimum 4 nights) call detection/call playback (minimum 2 nights)/ spotlighting (minimum 2 nights)/scat search (minimum 30- minutes) (Commonwealth of Australia, 2004; DEC 2004a).	Spotlighting, 27 to 29 April 2021 (6.30-8.30pm two nights/4 hours) 2x 30 min searches on 2 separate nights, 27 to 29 April 2021 (7.30-8.00pm two nights/1 hour) Searches for scats around base of feed trees search, 27 to 28 April 2021 (8 hours).
Mammals - Microbats	Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	Survey Period – November-January Survey method – harp trap/mist net (minimum 4 days)/acoustic detection (minimum 4 days)/ radiotracking/roost search (OEH, 2018).	Outside of recommended survey time however microbats were still recorded on detectors. The acoustic detection was also placed for a far greater number of nights than guidelines propose: – 26 April to 13 May 2021 (5pm-6am 18 nights/234 hours).
	Little Bent-winged Bat (<i>Miniopterus australis</i>)	Survey Period – December-February Survey method – harp trap (minimum 4 days) (OEH, 2018).	Outside of recommended survey time however microbats were still recorded on detectors. The acoustic detection was also placed for a far greater number of nights than guidelines propose:
	Large Bent-winged Bat (<i>Miniopterus oriana oceanensis</i>)	Survey Period – December-February Survey method –harp trap (minimum 4 days) (OEH, 2018).	– 26 April to 13 May 2021 (5pm-6am 18 nights/234 hours).
	Southern Myotis (<i>Myotis Macropus</i>)	Survey Period – October-March Survey method – harp trap/mist net (minimum 4 days)/acoustic detection (minimum 4 days)/ radiotracking/roost search (OEH, 2018).	Outside of recommended survey time however microbats were still recorded on detectors. The acoustic detection was also placed for a far greater number of nights than guidelines propose:
Moluscs	Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>) And Dural Land Snail (<i>Pommerhelix duralensis</i>)	Survey Period – All year. Survey method – Hand search under logs and other debris, amongst leaf and bark accumulations around bases of trees and under grass clumps.	Diurnal leaf litter search, 16 to 18 September 2020 (8 hours), and 27 to 28 April 2021 (8 hours).

4.2.3 Weather conditions

The daily temperatures at the closest weather station at Horsley Park Equestrian Centre (BoM 2021) which is about 10 kilometres south east of Mamre Road, have been provided in Table 4-5.

The mean weather conditions during the survey period include the following:

- September 2020: An average day temperatures of 25 degrees, and at lowest temperature of about 11 degrees during night surveys
- February/March 2021: An average day temperatures of 28 degrees, and at lowest temperature of about 17 degrees during night surveys
- April/May 2021: An average day temperatures of 22 degrees, and at lowest temperature of about 11 degrees during night surveys.

Table 4-5: Weather prior to and during field work

Date	Temperature Minimum	Temperature Maximum	Wind maximum km/h	Rain
13 September 2020	7.2	24.9	31	0
14 September 2020	8.4	23.1	30	0.2
15 September 2020	11.7	24.0	24	0
16 September 2020	10.2	27.9	26	0
17 September 2020	12.3	30.9	54	0
18 September 2020	12.8	17.6	13	0
19 February 2021	18.5	28.2	31	15.8
20 February 2021	18.3	29.9	26	0
21 February 2021	18.8	29.1	30	0
22 February 2021	18.9	30.6	35	0
23 February 2021	18.3	20.3	28	0.2
26 February 2021	14.8	29.9	35	2.6
27 February 2021	18.1	23.3	19	0.2
28 February 2021	18.2	29.8	30	0.2
1 March 2021	17.5	35	31	0
2 March 2021	16.6	22.7	19	0
6 March 2021	16.2	24.7	30	0
7 March 2021	13.4	27.4	26	0
8 March 2021	16.5	30.3	50	0
9 March 2021	16.6	31.8	41	5.2
24 April 2021	5.5	22.4	13	0
25 April 2021	5.6	22.1	26	0

Date	Temperature Minimum	Temperature Maximum	Wind maximum km/h	Rain
26 April 2021	9.2	22.7	15	0
27 April 2021	10.6	22.9	24	0
28 April 2021	10.8	22.2	15	0
29 April 2021	9.1	23.7	19	0
4 May 2021	12.4	15.7	28	0
5 May 2021	13.1	19.1	26	11.4
6 May 2021	14.6	21.3	50	18
7 May 2021	17.3	21.7	30	14.4
8 May 2021	12.3	25.3	19	0.4
9 May 2021	14.0	20.3	15	0
10 May 2021	10.8	24.1	30	0
11 May 2021	12.0	22.5	35	0.4
12 May 2021	12.1	21.4	20	0.2
13 May 2021	11.6	23.3	19	0

4.2.4 Limitations

General survey

The survey was designed primarily to detect threatened biodiversity listed as ‘species credit’ fauna, or threatened biodiversity listed on the EPBC Act. The survey did not entail multiple monitoring seasons as such level of assessment is not required.

Acoustic bat surveys

Acoustic surveys were conducted between April and May 2021. The acoustic survey was just outside the recommended survey period for threatened microbat species (October to March; DPIE 2018), however, climatic conditions at the time of the assessment were still mild (daily average temperature of 22°C) (Table 4-5). Microbats were also detected on the anabat recording units regardless of the recommended months. The team also supplemented the survey with a far greater number of trap nights than that specified in the guidelines.

Bat call identification analysis

Multiple bat species may call simultaneously, and therefore calls were assigned to a species if >50% of pulses within a sequence were assigned to that species and only passes with a minimum of three pulses classified to the same species were identified. Since linear calls produced by some species (i.e., *Nyctophilus* spp.) cannot be assigned to species level due to characteristic frequency overlap, they were grouped and labelled ‘*Nyctophilus* species’.

Calls were only positively identified when the defining characteristics were present and there was no chance of confusion between species with overlapping and/or similar calls. In this survey, there were some call sequences that could not be positively identified to species level. Further, some species recorded in this survey can have call profiles that overlap with other species. When overlap occurs, species with similar call profiles are assigned to multi species groups of two or three potential species depending on the characteristics displayed in the recorded call sequences.

Calls with intermediate characteristics were assigned mixed species labels. The species recorded in this survey with overlapping call profiles are described below. Large Bent-winged Bat calls overlap in frequency with those of and *Vespadelus darlingtoni* (Large Forest Bat) in the Sydney Basin.

The calls of Large Bent-winged Bats can be separated from the Forest Bats by a down-sweeping tail which neither of the Forest Bats displays (generally being up-sweeping or absent). Large Bent-winged Bat calls are often variable in pulse shape and time between pulses whereas the Forest Bats commonly have regular pulses evenly spaced pulses.

4.2.5 Terrestrial fauna and fauna habitat

Fauna species recorded in the proposal area are listed in Annexure B. A total 48 species were recorded during field surveys, comprising one mollusc, two fish, three frogs, three reptiles, 17 birds, and 22 mammals.

Seven threatened fauna species were recorded during the field survey within the proposal area, including: Cumberland Plain Land Snail, Grey-headed Flying-fox, Southern Myotis, Large Bentwing-bat, Little Bentwing-bat, Greater Broad-nosed Bat and Yellow-bellied Sheath-tail-bat.

Each of the threatened fauna above are discussed further in section 5.3.

Our assessment stratified the proposal area into different habitat types, which are shown on Figure 8 and are described below.

Woodland / Forest habitat

The habitats that occur within the proposal area consist of narrow areas of woody/forest habitat types comprising of the PCTs discussed in section 3.2. These areas are highly fragmented and disturbed, and are therefore considered unlikely to support a high diversity of non-urban tolerant fauna species.

The majority of canopy trees within the proposal area had a dbh of less than 20 centimetres, and multiple deteriorating tree protection sleeves were observed around the bases of trees suggesting that some of the area was previously cleared and has since regenerated. Midstorey vegetation across much of the proposal area was relatively patchy, and consists primarily of introduced species. A grassy ground layer is present and limited areas of leaf litter occurs around the larger trees.

The habitat resources occur close to the roads edge, in highly disturbed patches of vegetation with limited connectivity, and are subject to a high level of noise and light pollution. These factors likely limit these areas to only being suitable for highly urban tolerant species.



Photo 10. Patches of woodland immediately adjacent to Mamre Road

Hollow bearing trees and fallen timber

A hollow-bearing tree survey was carried out during the April-May 2021 field survey. The location of hollow-bearing trees and stags are provided in Annexure C and shown on Figure 7.

Ten hollow-bearing trees were recorded within the proposal area, which were predominantly *Eucalyptus moluccana*, with one *Eucalyptus eugenioides* and one *Eucalyptus tereticornis*. The size of the hollows ranged in size from less than 5 to 20 centimetres.

Trunks of hollow-bearing trees were inspected for glider feeding scars, and the base was inspected for the presence of owl pellets or prey, to which no evidence of usage was observed during the time of the survey.

Areas of hollow-bearing trees were also observed from vantage points during both diurnal and nocturnal surveys. The only fauna species observed leaving the hollows during the survey activity were Rainbow Lorikeets (*Trichoglossus haematodus*).

No hollow-bearing trees had suitable large enough for the subject threatened species based on information provided in the TBDC.

Limited areas of open woodland containing fallen timber occur, thus not presenting ideal habitat for the Bush Stone-curlew (*Burhinus grallarius*).

Culverts

Based on field observations, the concrete box girder bridge spanning South Creek and only one culvert appeared to have potential for roosting bats. The culvert was located adjacent to South Creek (near the intersection of Luddenham Road and Mamre Road) and was about one metre in diameter. All other culverts were assessed acoustically, however were considered marginal in dimensions (< 0.5 metres diameter). Despite this, thorough visual inspections of each culvert (i.e. searches for physical presence, guano, staining, ammonia-like odours, evidence of roost points, expansion joints, portholes, cracks and fissures) was not possible at the time of the assessment due to safety/access concerns, areas of water inundation in some areas of the culverts, debris and sharps, and risk of direct roost disturbance (if present). No suitable maternity caves/sites for Large Bentwing-bat or Little Bentwing-bat occur within or nearby the proposal area.



Photo 11. Potential microbat roosting habitat within culverts spanning a non-perennial stream north of the intersection of Mamre Road and Erskine Park Road

Riparian area

South Creek generally flows from south to north, meandering alongside the proposal area.

Two unnamed tributaries of South Creek, flowing north westerly and several other local drainage lines traverse the proposal area (Aurecon 2021).

The unnamed tributary 1 catchment and local drainage catchment is entirely urbanized with residential land use to the east of the proposal boundary. Most of the northern portion of the unnamed tributary 2 catchment is urbanized with a mix of residential and industrial land use, with the southern portion of the catchment currently consisting of agricultural land and remnant vegetation.



Photo 12. Forest/Woodland habitat immediately adjacent to riparian area

4.2.6 Threatened fauna results

The field survey entailed sufficient effort to determine the occurrence and potential for habitat within the proposal area, for the subject threatened fauna to occur (Annexure 1).

Seven threatened fauna species were recorded with the proposal area:

- **Cumberland Plain Land Snail** (listed as Endangered on BC Act): The Cumberland Plain Land Snail was recorded during leaf litter targeted searches during the September 2020 and February/March 2021 surveys. Two populations of the Cumberland Plain Land Snail were recorded on either side of Mamre Road as shown on Figure 8. Population 1 would likely extend into the neighbouring BioBank site, occupying an area of about 40 hectares, whilst Population 2 would be limited to the five hectare patch of vegetation between Erskine Park Road and Mamre Road.
- **Grey-headed Flying-fox** (listed as Vulnerable under both the BC Act and EPBC Act): The Grey-headed Flying Fox was observed flying over the proposal area during nocturnal surveys in April 2021. The field survey confirmed the absence of camp sites.
- **Southern Myotis** (listed as Vulnerable under the BC Act and is a Species Credit Species under the BAM): The species was acoustically recorded along South Creek near the bridge along Luddenham Road (Anabat location 871 (b); Figure 8).
- **Large Bentwing-bat** (listed as Vulnerable under the BC Act and as there is an absence of breeding habitat, the species is classed as Ecosystem Credit Species under the BAM): The species was acoustically recorded across five of the six Anabat locations (Figure 8).
- **Little Bentwing-bat** (listed as Vulnerable under the BC Act and as there is an absence of breeding habitat, the species is classed as Ecosystem Credit Species under the BAM): The species was acoustically recorded across two of the six Anabat locations (Figure 8).
- **Greater Broad-nosed Bat** (listed as Vulnerable under the BC Act and is an Ecosystem Credit Species under the BAM): The species was acoustically recorded across two of the six Anabat locations (Figure 8).
- **Yellow-bellied Sheath-tail-bat** (listed as Vulnerable under the BC Act and is an Ecosystem Credit Species under the BAM): The species was acoustically recorded across four of the six Anabat locations (Figure 8).

As per the BAM, each of the subject threatened fauna as per the BAM-C must be addressed. The threatened fauna species predicted or potentially occurring within the IBRA subregion as generated by the BAM-C were reviewed and refined post field survey on the basis of the vegetation types, condition and habitat features, as well as the results of field survey.

In accordance with Section 6.4 of the BAM the threatened fauna list of potentially occurring species may be further refined where:

- habitat constraints listed for the species in the TBDC are absent from the proposal area (or particular vegetation zones), or
- habitat constraints or microhabitats on which the species depends are sufficiently degraded such that the species is unlikely to use the proposal area, or
- the species is vagrant in the IBRA subregion, or
- an expert report is prepared (in accordance with Subsection 6.5.2 of the BAM) stating that the species is unlikely to be present on the proposal area.

The list of predicted and candidate species generated via the BAM-C is presented in Table 4-6. A status for each species is provided which represents the basis for deciding whether a species was present or absent from the proposal area. No ecosystem credit species were omitted from the BAM-C.

Table 4-6: Results for threatened fauna requiring survey in the BAM-C

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Anthochaera phrygia</i>	Regent Honeyeater	September; October; November; December	The proposal area does not occur within the 'important Regent Honeyeater' map as per the BAM Important Areas Map. Therefore the 'species credit' component associated with Regent Honeyeater breeding habitat is not triggered. The Regent Honeyeater is therefore not considered further.	Not considered further.
<i>Burhinus grallarius</i>	Bush-stone Curlew	All year	A targeted survey was completed during recommended survey time using call playback, and spotlighting. The species was not detected during targeted survey, and thus as per the BAM, the species is not required to be considered further.	Not considered further.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	October; November; December; January	As per the directions on the TBCD, hollow-bearing tree survey has been used to identify whether potential nest hollows are present (defined as hollows in forest and woodland eucalypts; (i) at least 9 m above the ground and, (ii) with hollow diameter of 10 cm or larger). Although a small number of hollows that are a suitable height and size are present, they are situated on the edge of a busy main road in an area considered to degraded to support this species. The Gang-gang Cockatoo therefore does not need a targeted survey and is therefore not considered further.	Not considered further.
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	January; February; March; October; November; December	The proposal area does not occur within a location that fits the distribution of the species as described in the Scientific Determination for the species - 'In New South Wales the species is found in coastal areas and at higher elevation in the south, but north of Newcastle at higher elevation only'. This is supported by the closest record for the Eastern Pygmy Possum, occurring 12.6 km to the west of the proposal area in the Blue Mountains area. Despite the habitat not being ideal for the species, we undertook spotlighting survey but did not record the species. Although the timing was outside of the recommended survey time provided in the TBCD, the LMCC (2014a) guidelines state that at any time of the year a survey may 'still detect the species, though the months of September to June are optimal'. Given that our survey was conducted in April only 1 month outside the months recommended by the BAM-C, but within the optimal months stated by LMCC (2014a), and that the proposal area is not in an area that fits the distribution of the species as described in the Scientific Determination for the species, the species is considered to have a low likelihood of occurrence.	Not considered further.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	January; November; December	The habitat descriptions provided in OEH (2018a) 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method' note that the Large-eared Pied Bat breeding habitat occurs within 2 km of caves, scarps, cliffs, rock and disused quarries. The proposal area does not occur within 2 km of such features. The species was also not recorded during the Anabat analysis. The use of bat call detector is the recommended method for recording this species LMCC (2014a). Given the absence of records and the distance from breeding resources, the proposal area is unlikely to support habitat for the Large-eared Pied Bat.	Not considered further.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	July to December	The White-bellied Sea-Eagle is a dual credit species, with breeding habitat triggering species credits. The TBCD states that 'Breeding habitat is live large old trees within 1km 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. Our surveys which were conducted within the recommended survey time did not record the presence of the White-bellied Sea-Eagle, nor did it record any large stick nests.	Not considered further.

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Hieraaetus morphnoides</i>	Little Eagle	April, September, October	<p>The Little Eagle is a dual credit species, with breeding habitat triggering species credits.</p> <p>Little Eagle Breeding habitat is defined in the TBCD as 'live (occasionally dead) 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'.</p> <p>Our surveys which were completed during recommended survey time did not record the presence of the Little Eagle, nor did it record any large stick nests.</p> <p>Therefore, it is concluded that the proposal area does not contain breeding habitat for the Little Eagle.</p>	Not considered further.
<i>Lathamus discolor</i>	Swift Parrot	May, June, July, August,	<p>The species is a dual credit species, with the species credit component mapped as an important area. These mapped areas do not require survey as it is presumed that the species is present. The proposal area does not occur within an important area.</p>	Not considered further.
<i>Litoria aurea</i>	Green and Golden Bell Frog	January, February, march, November, December	<p>The specific habitat requirements for the species as detailed in BioNet, habitat for the Green and Golden Bell Frog includes:</p> <ul style="list-style-type: none"> - 'marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). - water-bodies that are unshaded, free of predatory fish such as Plague Minnow.' <p>The site provides some suitable habitat for Green and Gold Bell Frogs due to the presence of waterbodies with macrophyte vegetation (i.e. <i>Typha</i> sp.), however the predatory fish Eastern Gambusia (<i>Gambusia holbrooki</i>) are present within the watercourses. As such, it is unlikely that the species is present at the site. Surveys were completed regardless during recommended survey times and included both spotlighting and call playback, which failed to detect the species.</p>	Not considered further.
<i>Lophoictinia isura</i>	Square-tailed Kite	January, September, October, November, December	<p>Breeding habitat is living 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.</p> <p>Our surveys which were conducted within the recommended survey time did not record the presence of the Square-tailed Kite, nor did it record any large stick nests.</p>	Not considered further.
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	All year	<p>Surveys completed during recommended survey times detected potentially, two populations of Cumberland plain land snail, one on the east and one other west Mamre Road (Figure 7). Additional surveys completed in April 2021 detected no additional populations.</p>	Considered further.

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Miniopterus australis</i>	Little Bentwing- Bat	January, February December	<p>Acoustic surveys were conducted between April and May 2021. The acoustic survey was just outside the recommended survey period for this species (December to February; DPIE 2018), however, climatic conditions at the time of the assessment were still mild (Table 4-5), and the detectors were left for a longer period to satisfy survey requirements (18 trap nights per Dectector). Despite, being outside of the recommended survey period we acoustically recorded this species in five of the six deployment locations.</p> <p>The highest number of passes recorded for this species was at location 875(b) (209 passes in total).</p> <p>In accordance with the BAM, this species is identified as a Dual Credit Species and is only considered to be a Species Credit Species for breeding habitat only. Breeding habitat (as defined in the BAM) needs to identified or assumed within the study area.</p> <p>Breeding habitat as identified by the BAM, states:</p> <p><i>“Caves, tunnels, mines or other structures known or suspected to be used by M. australis including species records in the NSW BioNet Atlas with microhabitat code ‘IC – in cave’; observation type code ‘E nest-roost’; with numbers of individuals >500; or from the scientific literature...all areas of potential breeding habitat on the subject land where breeding individuals of a threatened bat species are determined to be present.”</i></p> <p>The species has similar breeding/roosting ecology to Large Bentwing-bat and are often found co-roosting (Dwyer 1968). In NSW the largest maternity colony is in close association with a large maternity colony of Large Bentwing-bat and appears to depend on the large colony to provide the high temperatures needed to rear its young. None are known in the greater Sydney region.</p> <p>A 10-kilometre BioNet search of Little Bentwing-bat records identified multiple acoustic records within the broader surrounds. No records were no records with the microhabitat code ‘IC – in cave’; observation type code ‘E nest-roost’; with numbers of individuals >500.</p> <p>Based on multiple lines of evidence, the study area and broader surrounds are likely to support roosting (in the form of over wintering/hibernacula and day roosts) and foraging habitat only. Therefore, this species is classed as an Ecosystem Credit Species.</p>	Not considered further (Ecosystem Credit Species)

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<p><i>Miniopterus orianae oceanensis</i></p>	<p>Large Bentwing Bat</p>	<p>January, February, December</p>	<p>Acoustic surveys were conducted between April and May 2021. The acoustic survey was just outside the recommended survey period for this species (December to February; DPIE 2018), however, climatic conditions at the time of the assessment were still mild (Table 4-5), and the detectors were left for a longer period to satisfy survey requirements (18 trap nights per Dectector). Despite, being outside of the recommended survey period we acoustically recorded this species in five of the six deployment locations.</p> <p>The highest number of passes recorded for this species was at location 875(b) (209 passes in total).</p> <p>In accordance with the BAM, to be classed as a Species Credit Species breeding habitat needs to identified or assumed within the study area.</p> <p>Breeding habitat as identified by the BAM, states:</p> <p><i>“Caves, tunnels, mines or other structures known or suspected to be used by M. schreibersii oceanensis including species records in the NSW BioNet Atlas with microhabitat code ‘IC – in cave’; observation type code ‘E nest-roost’; with numbers of individuals >500; or from the scientific literature...all areas of potential breeding habitat on the subject land where breeding individuals of a threatened bat species are determined to be present.”</i></p> <p>Large Bentwing-bat has complex roosting ecology and tends to utilise different roost types at different times of the year. During winter, Females and males congregate in smaller colonies, which may occur in human made structures such as old mines, stormwater channels and disused buildings. These roosts are usually cool, which enables individuals to enter hibernation (can be up to 12 days at a time between feeds) to conserve energy when food sources are low. Mating takes place in late autumn or early winter (Dwyer 1995). Females are fertilised late autumn/early winter, but copulation doesn’t take place until shortly before the females emerge from hibernation in August. Females occupy the over-wintering roosts (like culverts) until they migrate in September when they move to maternity roosts (Dwyer 1963). During these migrations, females have been recorded moving at least 70 kilometres overnight between roosts. A distance of several hundred kilometres may be travelled between over-wintering sites and maternity roosts. In some cases, acclimatisation roosts may be used prior to the females moving to their maternity roosts. These roosts are believed to assist bats to adjust to the high humidity that is experienced in the maternity roost for creching young (Hoye and Spence 2004). Furthermore, only three major maternity roosts are known in New South Wales, Willi Willi caves near Kempsey, Drum Cave at Bungonia near Goulburn, and Church Cave at Wee Jasper (Hamilton Smith and Dwyer 1965). All three roosts occur in limestone karst systems and are located in domed caverns where the great number of bats elevate both temperature and humidity and in turn speed development of the young (Dwyer 1971). It is likely that unknown maternity roosts exist within the vicinity of Sydney (Wilson 2000).</p> <p>A 10-kilometre BioNet search of Large Bentwing-bat records identified multiple acoustic records within the broader surrounds, and harp trapping records, however, no greater than 2 individuals were physically observed/trapped. There were no records with the microhabitat code ‘IC – in cave’; observation type code ‘E nest-roost’; with numbers of individuals >500.</p> <p>The species is known to persist in the Greater Sydney region, as it has been documented adapting to the urban environment (Hoye and Spence 2004), it is an open space forager and will utilise artificial light as an attractant for prey and has been documented as roosting in artificial structures since 1892.</p> <p>Based on multiple lines of evidence, the study area and broader surrounds are likely to support roosting (in the form of over wintering/hibernacula and day roosts) and foraging habitat only. Therefore, this species is classed as an Ecosystem Credit Species.</p>	<p>Not considered further (Ecosystem Credit Species)</p>

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Myotis macropus</i>	Southern Myotis	January, February, October, November, December	<p>Acoustic surveys were conducted between April and May 2021. The acoustic survey was on the shoulder months of the recommended survey period (October to March; DPIE 2018), however, climatic conditions at the time of the assessment were still mild (Table 4-5), and the detectors were left for a longer period to satisfy survey requirements (18 trap nights per Dectector). Despite, being outside of the recommended survey period we acoustically recorded this species in one of the detector locations (871(b)).</p> <p>Southern Myotis has a high affinity with suitable waterbodies (home range is unlikely to extend beyond 200 metres of a waterbody forages along creek lines/riparian corridors and roosting in tree hollows, culverts, bridges and other man-made structures (Campbell 2009).</p> <p>In accordance with the BAM, this species is classified as Species Credit Species for breeding and foraging habitat within the study area. Therefore, this species habitat will require further consideration in accordance with the BAM.</p>	Further consideration required. Species is a Species Credit Species
<i>Ninox connivens</i>	Barking Owl	March to December	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding can be identified by "suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified".</p> <p>The BAM-C lists the following habitat constraints in reference to potential habitat for the Barking Owl.</p> <ul style="list-style-type: none"> - Hollow bearing trees. - Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground. <p>The proposal area does not contain any suitable hollows that constitute potential breeding habitat. We completed the spotlighting surveys at the end of April 2021 which is only one week before the start of the recommended survey times. Our field survey did not record the Barking Owl on the proposal area, nor any nests during the hollow-bearing tree surveys. Thus, breeding habitat is considered unlikely to occur within the proposal area.</p>	Not considered further.
<i>Ninox strenua</i>	Powerful Owl	May, June, July, August	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding can be identified by "suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified".</p> <p>The BAM-C lists the following habitat constraints in reference to potential habitat for the Powerful Owl.</p> <ul style="list-style-type: none"> - Hollow bearing trees. - Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground. <p>The proposal area does not contain any suitable hollows that constitute potential breeding habitat. We completed the spotlighting surveys at the end of April 2021 which is only one week before the start of the recommended survey times. Our field survey did not record the Powerful Owl on the proposal area, nor any nests during the hollow-bearing tree surveys. Thus, breeding habitat is considered unlikely to occur within the proposal area.</p>	Not considered further.
<i>Pandion cristatus</i>	Eastern Osprey	April to November	<p>Survey completed during recommended survey time.</p> <p>Our surveys which were conducted within the recommended survey time did not record the presence of the Eastern Osprey, nor did it record any large stick nests.</p>	Not considered further.

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Petaurus norfolcensis</i>	Squirrel Glider	All year	Survey completed during recommended survey time and was not detected, nor has the species been recorded within the South Creek corridor during surveys for the Growth Centres, including the Airport which occurs greater habitat to that of the proposal area. The proposal area is a highly disturbed roadside areas subject to noise and light pollution.	Not considered further.
<i>Phascolarctos cinereus</i>	Koala	All year	Survey completed during recommended survey time and was not detected. Given the small number of records which occur in the locality, the presence of predominately younger trees, and the lack of connectivity to nearby bushland, it is unlikely that this species occurs within the proposal area.	Not considered further.
<i>Pommerhelix duralensis</i>	Dural Land Snail	All year	Surveys were completed during recommended survey time. No Dural Land Snails were detected. Given that Cumberland Plain Land Snails were detected during these surveys which are of a similar size and utilise similar habitat, it is considered likely that this species would have been detected during these same surveys if present. Additionally, this species more commonly occurs further north and is rare in the Penrith LGA.	Not considered further.
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	October, November, December	Survey was not completed during the recommended survey time, however as the species was detected in April no additional surveys are required to confirm presence. It should be noted that this species was observed flying over the proposal area and foraging in trees within the proposal area, but is not believed to roost or breed within the proposal area. The nearest breeding camp is located about 3.3km north-east of the proposal area, and was reported to contain between 500-2,499 individuals when it was last surveyed in February 2020 (Commonwealth of Australia, 2020).	Not considered.
<i>Tyto novaehollandiae</i>	Masked Owl	June, July, August, September	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding can be identified by "suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified".</p> <p>The BAM-C lists the following habitat constraints in reference to potential habitat for the Masked Owl.</p> <ul style="list-style-type: none"> - Hollow bearing trees. - Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground. <p>The proposal area does not contain any suitable hollows that constitute potential breeding habitat. We completed the spotlighting surveys at the end of April 2021 which is only one week before the start of the recommended survey times. Our field survey did not record the Masked Owl on the proposal area, nor any nests during the hollow-bearing tree surveys. Thus, breeding habitat is considered unlikely to occur within the proposal area.</p>	Not considered further.
Predicated threatened fauna				
<i>Anthochaera phrygia</i>	Regent Honeyeater	No requirement to survey for these species, as the BAM-C assumes presence.		
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow			
<i>Botaurus poiciloptilus</i>	Australasian Bittern			
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo			
<i>Chthonicola sagittata</i>	Speckled Warbler			

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Circus assimilis</i>	Spotted Harrier			
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)			
<i>Daphoenositta chrysoptera</i>	Varied Sittella			
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll			
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle			
<i>Glossopsitta pusilla</i>	Little Lorikeet			
<i>Grantiella picta</i>	Painted Honeyeater			
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle			
<i>Hieraaetus morphnoides</i>	Little Eagle			
<i>Ixobrychus flavicollis</i>	Black Bittern			
<i>Lathamus discolor</i>	Swift Parrot			
<i>Lophoictinia isura</i>	Square-tailed Kite			
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)			
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)			
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat			
<i>Miniopterus australis</i>	Little Bent-winged Bat			
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat			
<i>Neophema pulchella</i>	Turquoise Parrot			
<i>Ninox connivens</i>	Barking Owl			
<i>Ninox strenua</i>	Powerful Owl			
<i>Pandion cristatus</i>	Eastern Osprey			

Scientific Name	Common name	Survey effort	Survey completed and justification if the threatened species needs to be considering further	Further consideration?
<i>Petaurus australis</i>	Yellow-bellied Glider			
<i>Petroica boodang</i>	Scarlet Robin			
<i>Petroica phoenicea</i>	Flame Robin			
<i>Phascolarctos cinereus</i>	Koala			
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox			
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat			
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat			
<i>Stagonopleura guttata</i>	Diamond Firetail			
<i>Tyto novaehollandiae</i>	Masked Owl			

4.2.7 Threatened fauna for further consideration

As discussed in Table 4-2, our survey and analysis confirm that two threatened fauna requiring species credits were recorded within the proposal area: Southern Myotis and the Cumberland Plain Land Snail, and as such both species require further consideration. The area of potential habitat that occurs within the proposal area (referred to as the species polygon) has been provided in Table 4-7 (shown in Figure 9 and Figure 10), and the associated impacts to the area of habitat has been discussed in section 7.3.

Table 4-7. Potential habitat for Cumberland Plain Land Snail and Southern Myotis

Species	Potential habitat	Area of potential habitat (ha)
Cumberland Plain Land Snail	<p>Two populations of the Cumberland Plain Land Snail were recorded during the targeted survey as shown on Figure 7. The potential habitat includes the vegetation to the far south of the proposal area as shown on Figure 10, given this area contains a known population of the species.</p> <p>The potential habitat comprises of about:</p> <ul style="list-style-type: none"> - 0.19 hectares of PCT 835 low - 1.12 hectares of PCT 835 medium - 0.41 hectares of PCT 849 low - 1.55 hectares of PCT 849 medium - 0.13 hectares of PCT 1800 medium. 	3.40
Southern Myotis	<p>The Southern Myotis was recorded at the location shown on Figure 8.</p> <p>In order to determine the area of potential habitat for the species, the TBDC states that <i>'all habitat on the subject land where the subject land is within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject land must be mapped. Use aerial imagery to map waterbodies with pools/ stretches 3m or wider on or within 200m of the subject land. Species polygon boundaries should align with PCTs on the subject land to which the species is associated that are within 200m of waterbodies mapped.'</i></p> <p>This assessment has therefore mapped all habitat within 200 metres of a waterbody as shown on Figure 9. We have determined suitable habitat to include the following vegetation types within the proposal area:</p> <ul style="list-style-type: none"> -1.42 hectares of PCT 835 low -2.6 hectares of PCT 835 medium -0.07 hectares of PCT 849 low -1.53 hectares of PCT 849 medium - 0.47 hectares of PCT 1800 medium. 	6.12

4.3 Aquatic ecology

4.3.1 Aquatic survey

Aquatic habitat assessments were completed in September 2020 at the waterways that intersected the proposal area. These waterways were streams that drained towards South Creek and Blaxland Creek to the west of Mamre Road. These streams flowed through the vegetation communities at the northern, south-western and south-eastern sections of the proposal and were assessed for habitat features and quality during the vegetation surveys.

The survey entailed collection of water depth, basic flow and substrate of banks and bed of the watercourse. General condition of the riparian area was also noted.

The purpose of the survey was to assist in determining the likelihood for fish movement throughout the watercourse, and to determine the presence/absence for threatened fish Macquarie Perch and Australian Grayling.

4.3.2 Aquatic results

South Creek generally flows from south to north, alongside the proposal area.

Two unnamed tributaries of South Creek, flowing north westerly traverse the proposal boundary (Figure 2). Several other local drainage lines also traverse the proposal area.

The depth of each waterway recorded were less than 50 centimetres at the time of survey, with bed substrates of sands and gravels. Aquatic flora species recorded at these streams included *Alisma plantago aquatica* (Common Water-Plantain), *Centella asiatica* (Indian Pennywort), and *Myriophyllum aquaticum* (Parrot's Feather).

The field survey confirmed the presence of heavy rubbish and debris within the watercourse, which created barriers and small pools.

During the field survey, a Shortfin Eel and Mosquito Fish were recorded in one of the larger pools at South Creek, adjacent to the proposal area.

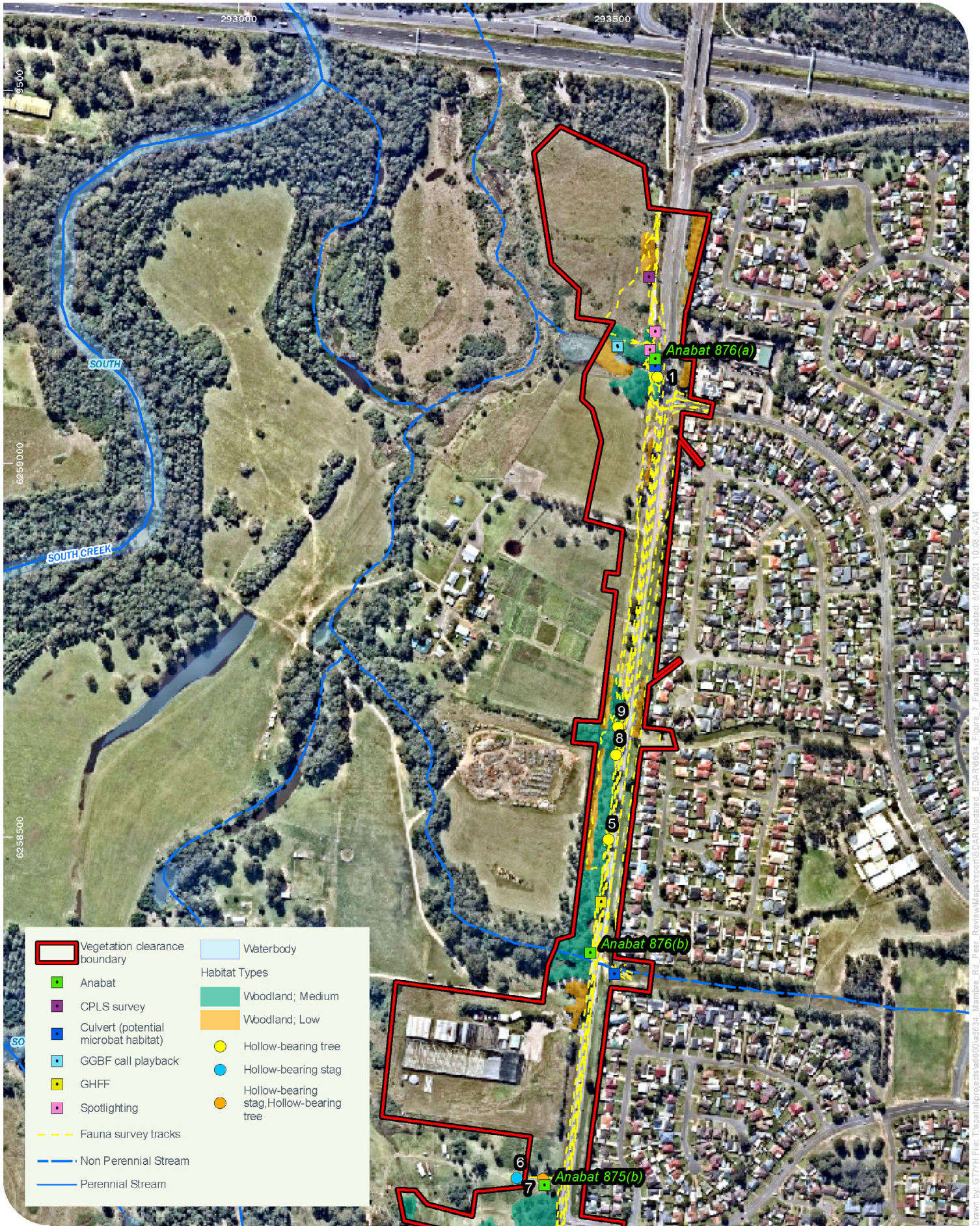
South Creek has been mapped as Key Fish Habitat, and it is categorised as Type-1 Highly Sensitive Key Fish habitat as it meets the following criteria (DPI 2013):

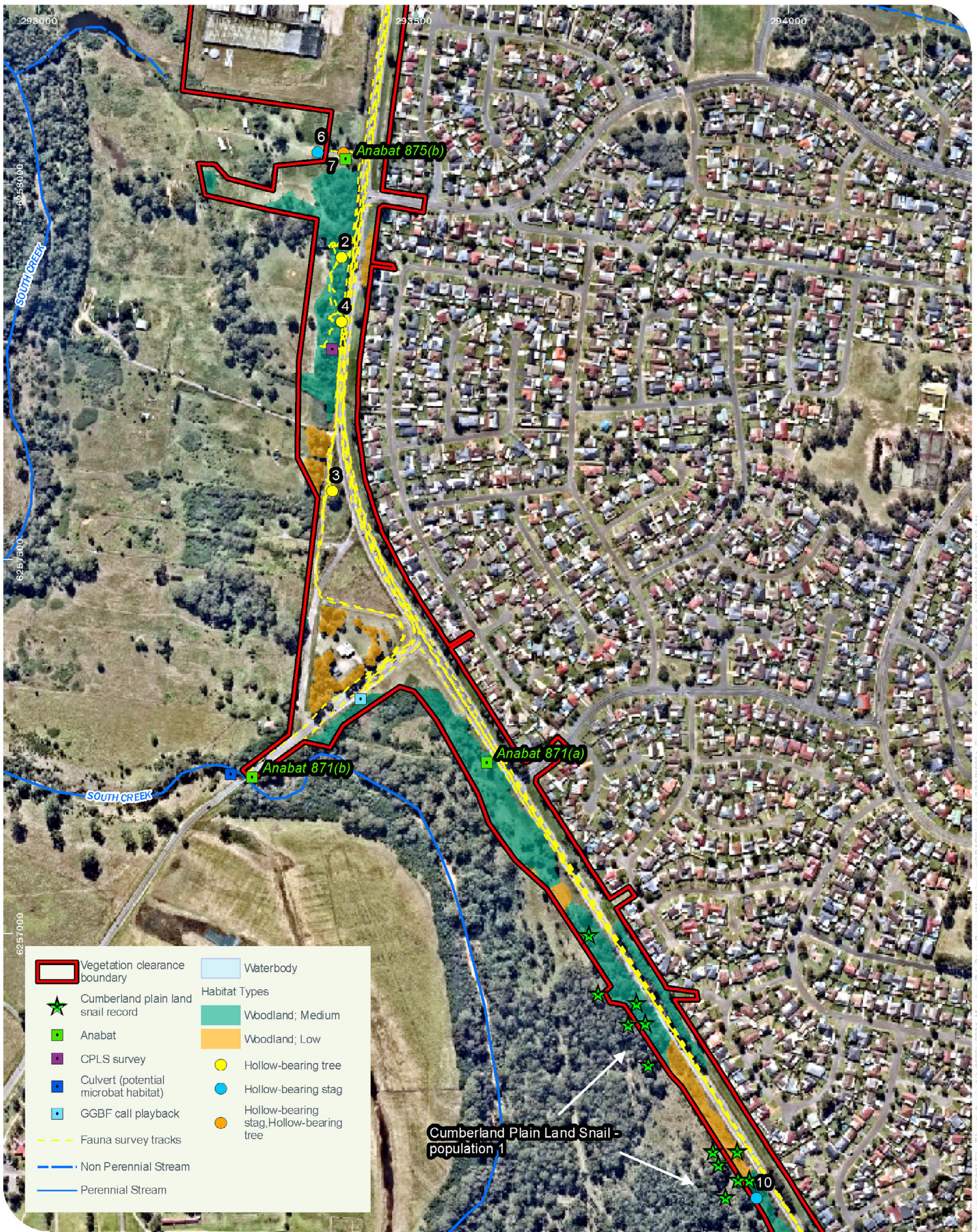
'Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants'.

The Waterway classification of South Creek is regarded as a Class 1 Major Key Fish Habitat as it is a permanent flowing waterway and considered for fish movement (DPI 2013).

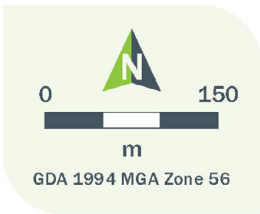
South Creek therefore has the potential to be habitat for a freshwater fish community. However, the creek contains barriers from existing culverts, rubbish dumping and sediment build up in areas, which would limit fish movements in times of low flow.

Both Macquarie Perch and the Australian Grayling have not been recorded within South Creek. It is highly unlikely both species would occur within South Creek in the proposal area given the degraded condition of the waterway and lack of historical records.





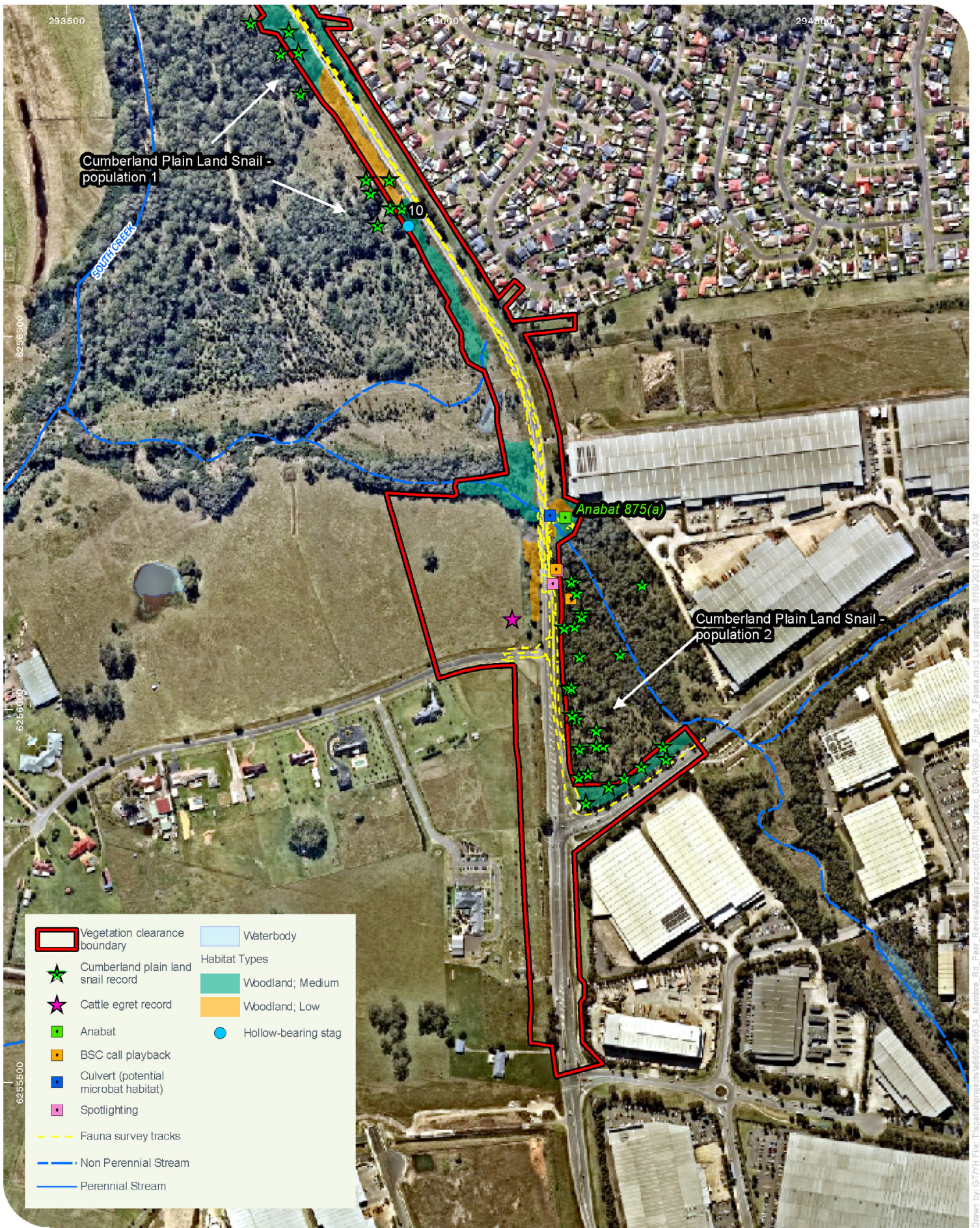
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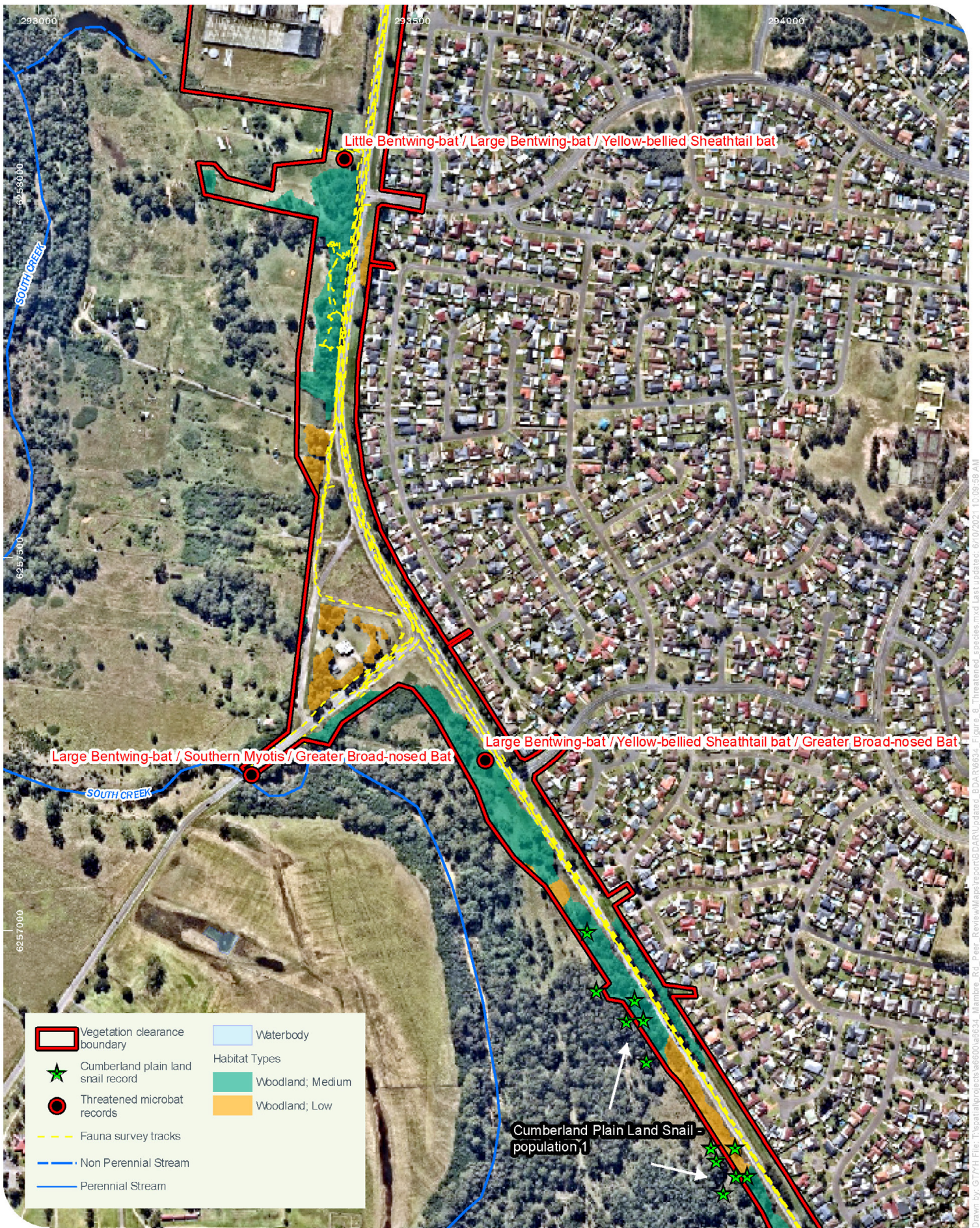


Threatened fauna survey effort
Mamre Road Upgrade – Stage 1
Biodiversity Development Assessment Report (BDAR)

Niche PM: Luke Baker
Niche Proj. #: 6634
Client: Transport for NSW / Aurecon

Figure 7.2





Vegetation clearance boundary	Waterbody
Cumberland plain land snail record	Habitat Types
Threatened microbat records	Woodland; Medium
Fauna survey tracks	Woodland; Low
Non Perennial Stream	
Perennial Stream	



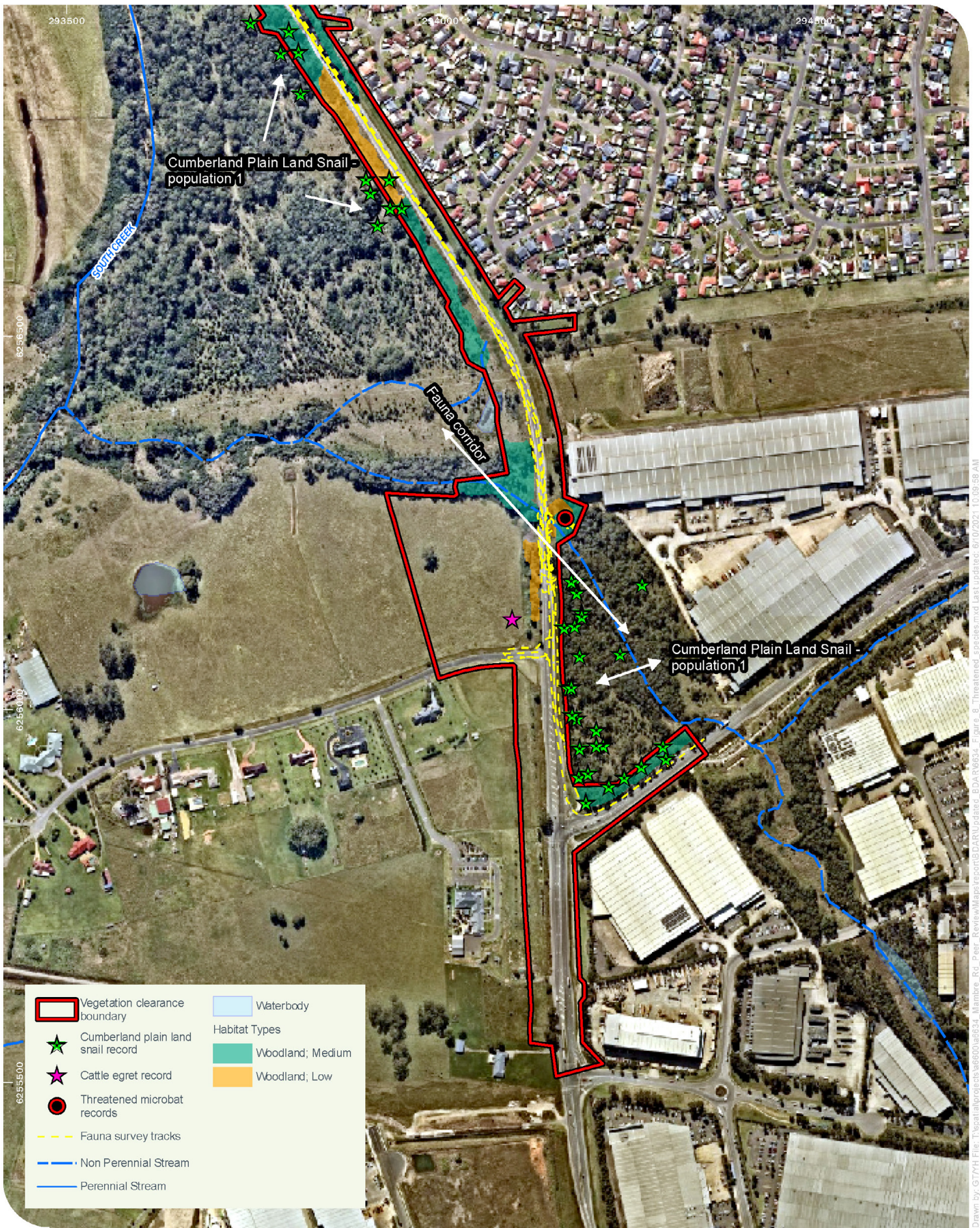
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 6634
Client: Transport for NSW / Aurecon

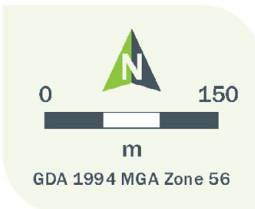
Threatened species survey results
Mamre Road Upgrade – Stage 1
Biodiversity Development Assessment Report (BDAR)

Figure 8.2

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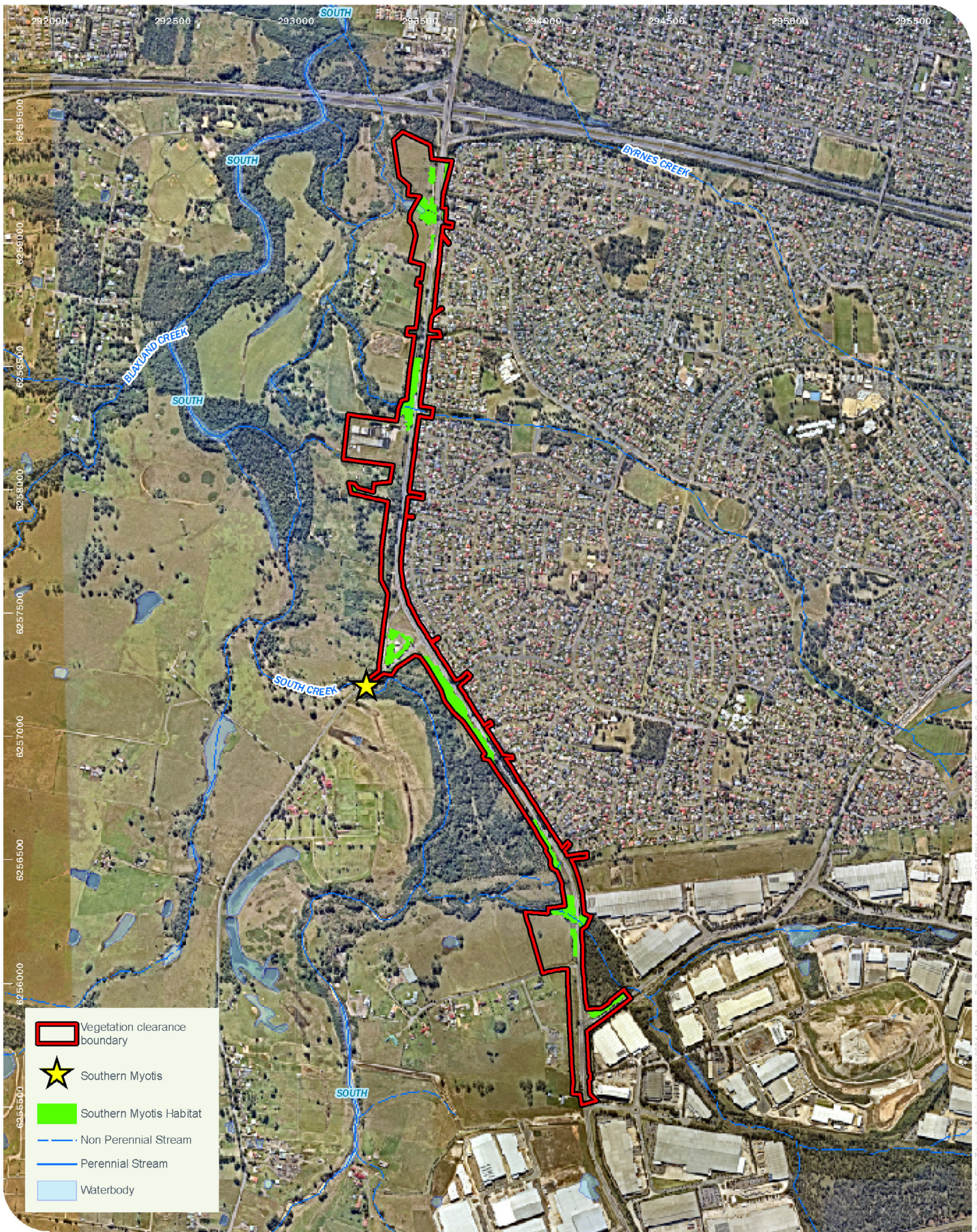
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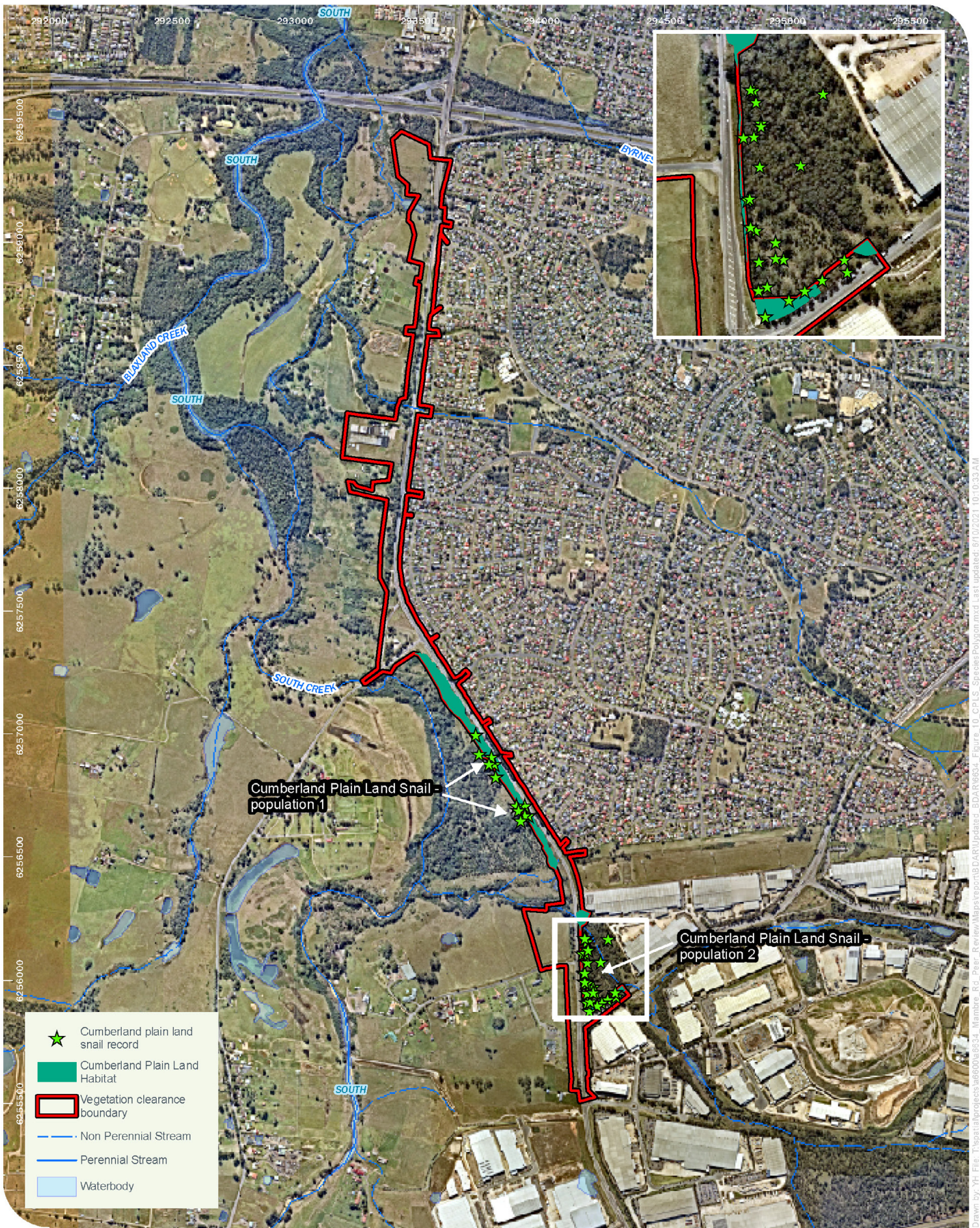


Threatened species survey results
 Mamre Road Upgrade – Stage 1
 Biodiversity Development Assessment Report (BDAR)

Niche PM: Luke Baker
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Figure 8.3





5 Matters of National Environmental Significance

5.1 EPBC Act listed Threatened Ecological Communities

The Protected Matters Search Tool (PMST) listed seven TECs that may occur in or nearby the proposal area (Annexure D). As discussed in section 3.4, the proposal area contains two PCTs that meet the description of TECs under the EPBC Act:

- PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion meets the definition of the CEEC Cumberland Plain Woodland in the Sydney Basin Bioregion. About 3.63 hectares of the Commonwealth TEC occurs within the proposal area.
- PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion meets the definition of the CEEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. About 2.84 hectares of the Commonwealth TEC occurs within the proposal area.

The impacts to both Commonwealth listed TECs are discussed in section 5, and a Commonwealth Assessment of Significance has been provided in Annexure E for both TECs.

5.2 EPBC Act listed threatened flora

The PMST listed 22 threatened species that may have habitat within the proposal area and locality. As discussed in section 4.1.3, the field survey did not record any threatened flora within the proposal area. The field survey and analysis of the habitat requirements associated with each threatened flora determined a low likelihood for threatened flora to occur within the proposal area. As such, no further consideration of threatened flora under the Commonwealth EPBC Act is required.

5.3 EPBC Act listed threatened fauna

The PMST listed 45 threatened fauna species and 15 migratory species that may have habitat within the proposal area and locality.

The field survey confirmed the presence of one Commonwealth listed threatened fauna: Grey-headed Flying Fox (Vulnerable), and the Cattle Egret which is listed as a 'Marine' species. The proposal area was also considered to have some moderate likelihood of habitat for the Yellow Wagtail (Migratory) given the species can occupy relatively open/cleared environments. The proposal area would provide foraging potential for the species, and is unlikely to be breeding habitat.

No other threatened fauna listed on the EPBC Act are likely to occur within the proposal area as detailed in Annexure A.

The impacts to Commonwealth listed fauna species are described in section 5, and a Commonwealth Assessment of Significance for the species has been provided in Annexure E.

6 Avoid and minimise impacts

This section details how the proposal would in the first instance avoid impacts to biodiversity, then use mitigation measures where avoidance is not possible.

6.1 Avoidance and minimisation

In accordance with the BAM, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a proposal on biodiversity values. This section of the report outlines the details from the REF associated with avoidance and planning that TfNSW has incorporated into the proposal design or would employ during construction or operation of the proposal to reduce impacts on biodiversity values. Mitigation measures have also been detailed in section 8 to further reduce impacts.

6.1.1 Avoid or minimise biodiversity impacts when locating the proposal

As detailed in the REF, the NSW Government has identified the need to progressively upgrade arterial roads in Western Sydney to deliver a more efficient, reliable network. This has been driven by the need for sufficient road infrastructure to support predicted future economic and residential growth in the area. As part of this, an upgrade of Mamre Road was identified to be required.

Four strategic options were identified for the proposal: a 'do nothing' option, widening along the western side, widening along the eastern side and a new alignment option.

With the exception of the 'do nothing' option, all proposed strategic options that were considered would have impacts to threatened biodiversity, given Mamre Road is surrounded by several areas of native vegetation that comprise threatened and endangered ecological communities (refer to Section 3.4). Some of this vegetation has been specifically identified for conservation, including vegetation within the biobank site south of Luddenham Road, areas zoned for environmental conservation on the Penrith Local Environmental Plan 2010 and a potential future biobank site proposed near Mamre House.

Widening Mamre Road along the western side was determined as the preferred option due to:

- the reduced amount of private property that would require acquisition compared to widening to the east or a new alignment
- the established development on the eastern side of Mamre Road, which would result in more amenity impacts (e.g. noise and visual impacts) and constrain the design
- the ability for a widening to the west to provide improved access to future parkland
- the potential for a new alignment option to result in greater environmental impacts than the road widening options, as widening would follow an existing area of disturbance
- the inability for the 'do nothing' option to provide sufficient capacity to support future economic growth or development in the surrounding area
- the inability of the 'do nothing' option and 'new alignment' option to improve the road safety or experience or access along the existing Mamre Road corridor.

Overall, the preferred option would likely result in less impacts to biodiversity than a completely new road alignment. However, it would result in a larger unavoidable biodiversity impact compared to the 'do nothing' option or widening along the eastern side of Mamre Road.

6.1.2 Design the proposal to avoiding or minimising impacts to biodiversity

Following identification of the preferred option, the design of the proposal and indicative construction methodology were developed. The design refinement process sought to avoid or minimise biodiversity impacts as much as practical by focusing on:

- reducing vegetation clearing by locating temporary infrastructure and compound sites in cleared areas, where possible
- limiting vegetation clearing only to areas that are considered necessary for construction and operational purposes
- reducing biodiversity impacts to the Luddenham Road BioBank site by refining the design of the road and associated drainage and water quality infrastructure
- minimising impacts within riparian areas as far as practical, while balancing the need to implement measures to manage water quality runoff and drainage from the road.

During concept design development for the preferred option, design refinements considered those listed in section 7.1.2 of the BAM (addressed in Table 6-1 below) to minimise biodiversity impacts.

A key refinement was associated with identification of a 'vegetation clearance boundary' within the larger proposal area, beyond which no vegetation clearance would be permitted. The area between the vegetation clearance boundary and the proposal area is considered a 'no-go' zone for construction activities.

The process of developing the vegetation clearance boundary involved optioneering to refine the footprint of permanent aspects of the design with an aim to reduce biodiversity impacts. This particularly focused on refinement and optioneering of the tail-out channel work and proposed locations of water quality basins and swales to minimise removal of vegetation, where possible. This was because these were the aspects of the design that most influenced the vegetation clearing requirements beyond the proposed widened road footprint.

For example, the design reduced impacts to the Luddenham BioBank site by moving the original location of a proposed water quality basin from the vegetated area south of Luddenham Road, to a cleared area north of Luddenham Road near Erskine Park Rural Fire Service, away from the BioBank site. The remaining swales along the road verge south of Luddenham Road have been designed to minimise vegetation clearing as far as practical along the edge of the BioBank site. These swales were not removed from the design completely, as they were considered important to capture road runoff prior to discharge into South Creek. The refined design resulted in a minor impact (about 0.02 ha) to the far northern edge of the BioBank site.

Table 6-1. Designing proposal – avoiding and minimising direct and indirect impacts on native vegetation, threatened species, threatened ecological communities and their habitats

Avoidance	Proposal
<p>Reducing the proposal's clearing footprint by minimising the number and type of ancillary facilities</p>	<p>Vegetation clearing for the proposal is unavoidable, given the location of the native vegetation immediately adjacent to Mamre Road.</p> <p>The direct impacts have been reduced as far as practical through refinement and optioneering of the tail-out channel work and proposed locations of water quality basins and swales.</p> <p>Temporary compound sites for construction of the proposal have been located within cleared areas to avoid additional vegetation and habitat disturbance.</p> <p>All areas outside of the vegetation clearance boundary are considered 'no go' zones for construction activities, and would be suitability demarcated prior to construction works commencing, and communicated to all staff and contractors.</p>
<p>Locating ancillary facilities in areas that have no biodiversity values</p>	<p>The proposal area consists predominately of cleared land, which accounts for about 79 per cent of the proposal area.</p> <p>Temporary compound sites have been located within previously cleared areas within the proposal area to reduce impacts to biodiversity values.</p>
<p>Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas with the lowest vegetation integrity scores)</p>	<p>As above, temporary compound sites have been proposed within cleared areas to avoid impacts to biodiversity.</p>

Avoidance	Proposal
<p>Locating ancillary facilities in areas that avoid habitat for species and vegetation that has a high threat status (e.g. an endangered ecological community (EEC) or critically endangered ecological community (CEEC) or is an entity at risk of a serious and irreversible impact (SII))</p>	<p>The proposal would result in an unavoidable impact to TECs. In particular, the proposal would have an impact to about 4.36 ha of Cumberland Plain Woodland which is regarded as a SII Candidate entity (Section 7.4).</p> <p>All impacts to TECs have been reduced as far as practical during the design process. Key measures to maximise avoidance of impacts to TECs include:</p> <ul style="list-style-type: none"> • Placement of temporary infrastructure within cleared areas. • Reduction of vegetation clearing within the Luddenham Road BioBank site. The design has avoided impacts to biodiversity as much as practical in this area, thus now only resulting in an impact to less than 0.02 ha of the BioBank site which supports both Cumberland Plain Woodland and River-Flat Eucalypt Forest TECs. • Area of TECs to be impacted is subject to existing edge effects from the existing road, including weed occurrence, sedimentation, erosion and some debris. • The design minimises impacts to Commonwealth TECs as the lower condition zones of Cumberland Plain Woodland and River-flat Eucalypt Forest do not meet the Commonwealth definition (section 3.4).
<p>Actions and activities that provide for rehabilitation, ecological restoration and/or ongoing maintenance of retained areas of native vegetation, threatened species, threatened ecological communities and their habitat on the subject land.</p>	<p>The construction and operation activities associated with the proposal would be carried out using best practice guidelines as detailed in section 8.</p> <p>Tubestock would be planted within the proposal area as per the Aurecon (2021b) Mamre Road Upgrade, Stage 1 Between M4 Motorway & Erskine Park Road, NSW Urban design report including landscape character and visual impact assessment. The planting would support local fauna habitat and connectivity for fauna.</p>

6.1.3 Avoid or minimise prescribed biodiversity impacts when locating the proposal

Prescribed biodiversity impacts are impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. This can include impacts on geological features (karst, caves, cliffs etc), human-made structures, connectivity of habitat, water quality and hydrological processes, and vehicle strike.

The proposal area is located away from karsts, caves, and cliff lines. Such features would therefore not be impacted by the proposal.

Prescribed impacts that are applicable to the proposal area include human made structures (i.e. houses, culverts), connectivity of habitat and water quality and hydrological processes. The widening of Mamre Road along the western side was determined as the preferred option for the proposal based on the reasons provided in section 6.1.2. Avoiding the impacts to the human made structures, connectivity and water quality were not possible.

To minimise prescribed biodiversity impacts, the location of the proposal considered the following:

- refinement and optioneering of the tail-out channel work and proposed locations of water quality basins and swales to minimise the removal of vegetation. These were the aspects of the design most influenced the vegetation clearing requirements beyond the proposed widened road footprint
- locating the vegetation clearing to the edge of Mamre Road as far as practical, to minimise impacts to habitat connectivity
- locating temporary infrastructure and compound sites in cleared areas, where possible to reduce impacts to habitat and connectivity

6.1.4 Design the proposal to avoid or minimise prescribed biodiversity impacts

The design of the proposal has implemented the following to avoid or minimise prescribed biodiversity impacts:

- minimising impacts within riparian areas as far as practical, while balancing the need to implement measures to manage water quality runoff and drainage from the road. Limiting vegetation clearing within close proximity to watercourses minimises potential impacts to foraging habitat for the Southern Myotis, and assists in preventing erosion of creekline habitat.
- maintain the existing hydrological flows within the watercourses of the proposal area through a suitable culvert and gross pollutant trap design
- replace fencing to the north of the Luddenham BioBank site to minimise potential for vehicle strikes.

The proposal would also employ a microbat management plan (section 8.1) to minimise potential impacts to roosting habitat during the culvert construction process.

Furthermore, the design criteria provided in section 7.2.2 of the BAM, has been addressed in Table 6-2 below to demonstrate proposal avoidance or minimisation to prescribed impacts.

Table 6-2. Designing the proposal to avoid or minimise prescribed impacts

Design measures that can avoid and minimise prescribed impacts	Proposal
<p>a. Engineering solutions, such as proven techniques to:</p> <ul style="list-style-type: none"> i. minimise fracturing of bedrock underlying features of geological significance, or groundwater-dependent communities and their supporting aquifers ii. restore connectivity and movement corridors 	<ul style="list-style-type: none"> i. The proposal is not located within an area that contains Coastal Upland Swamps, or other important Groundwater dependent ecosystems. As discussed in section 7.7, the potential for impacts to groundwater dependent ecosystems are minor in nature, which is supported by the <i>Aurecon (2021) Water quality and soil impact assessment</i> for the proposal. ii. The <i>Aurecon (2021b) Mamre Road Upgrade, Stage 1 Between M4 Motorway & Erskine Park Road, NSW Urban design report including landscape character and visual impact assessment</i> for the proposal would include the planting of native tubestock throughout the proposal area which would provide habitat and increase connectivity for fauna.

Design measures that can avoid and minimise prescribed impacts	Proposal
<p>b. Design elements that minimise interactions with threatened entities, such as:</p> <ul style="list-style-type: none"> i. designing turbines to dissuade perching and minimise the diameter of the rotor swept area ii. designing fencing to prevent animal entry to transport corridors iii. providing vegetated buffers rehabilitated with native species 	<ul style="list-style-type: none"> i. Not applicable ii. Fauna proof fencing has not been proposed along the edge of the proposal area. This was not considered necessary given the lack of habitat availability on the eastern side of Mamre Road. A portion of fencing to the north of the Luddenham BioBank site would need to be removed and replaced given the impacts associated with the proposal. The remaining fence line would be maintained along the edge of the Luddenham BioBank site. iii. The proposal would include the implementation of the Aurecon (2021b) <i>Mamre Road Upgrade, Stage 1 Between M4 Motorway & Erskine Park Road, NSW Urban design report including landscape character and visual impact assessment</i>. This would include the planting of native tubestock, including eucalypts and casuarina throughout the proposal area, which would ultimately provide fauna foraging and habitat resources.
<p>c. Maintaining environmental processes that are critical to the formation and persistence of habitat features not associated with native vegetation</p>	<p>The proposal would result in the upgrade of the existing culverts within the proposal area. The proposed culverts have been designed to maintain hydrological flow to be similar to that of the natural flow regime, where possible. Maintaining the hydrological flow would continue to support foraging habitat for the Southern Myotis which is known to occur in the locality.</p>
<p>d. Maintaining hydrological processes that sustain threatened entities</p>	<p>As per above, the natural flow regime of the watercourses would not be significantly altered due to the proposal. As such, foraging habitat for the Southern Myotis that occurs downstream of the watercourses, would not be significantly impacted by the proposal.</p> <p>The proposal has been designed to improve drainage. Swales and water quality basins have been proposed in several areas to assist with minimising impacts to water quality from road runoff.</p>
<p>e. Controlling the quality of water released from the site, to avoid or minimise downstream impacts on threatened entities.</p>	<p>The proposal has incorporated swales and water quality basins to improve water quality released from the proposal area and minimise impacts on downstream threatened entities (section 7.5.3).</p>

7 Impact assessment

7.1 Direct impacts on native vegetation and habitat

The proposal would have unavoidable impacted to biodiversity, including threatened biodiversity through both direct and indirect impacts during construction and operation.

The direct and indirect impacts associated with the proposal and measures to offset and manage biodiversity in the long term are outlined in the following sections.

The proposal would result in the clearing of 9.38 hectares of vegetation regarded as 'native vegetation,' as defined in the BAM. The majority of vegetation likely to be affected by the proposal has been subject to historic clearing, grazing, and other agricultural activities, and is therefore thinned in areas, and dominated in areas by a range of introduced species. This is evident in all condition classes of the vegetation to be impacted.

The area of impact including the vegetation integrity score has been provided in Table 7-1 below.

Table 7-1: Direct impacts to native vegetation

Vegetation zone	PCT	Status (BC Act)	Area to be impacted (ha)	Future value	Change (loss) in vegetation integrity score	Number of hollow bearing trees impacted
849_Moderate	849 - Cumberland shale plains woodland	CEEC	3.63	0	-48.6	0
849_Low	849 - Cumberland shale plains woodland	CEEC	0.92	0	-7.6	0
835_Moderate	835 - Cumberland riverflat forest	EEC	2.84	0	-72.4	0
835_Low	835 - Cumberland riverflat forest	EEC	1.52	0	-27.6	0
1800_Moderate	1800 - Cumberland Swamp Oak riparian forest	EEC	0.47	0	-36.1	0

7.2 Indirect impacts on native vegetation and habitat

Indirect impacts occur when the proposal or activities relating to the construction or operation of the proposal affect native vegetation, threatened ecological communities and threatened species habitat beyond the proposal area.

A range of indirect impacts are likely to or could occur as a result of the proposal, including:

- increased noise, dust and light from the construction and operational activities
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of native vegetation within the proposal area
- erosion or sedimentation in areas adjoining construction and operational activities
- increased spreading of weed propagules
- increased edge-effects for surrounding vegetated areas.

Such impacts would generally have a short to medium timeframe (i.e. the construction phase) and will be minimised through management procedures and processes.

The indirect impacts described above are variable in terms of the distance they may extend from the proposal area, and in many cases, due to mitigation measures, indirect impacts would be completely contained within the proposal area.

The area of indirect impact without mitigation measures has been attributed to a 50 metre area around the boundary of the site, which is consistent with the TfNSW indirect impact guidelines (TfNSW 2021) (Figure 3). This buffer would likely encapsulate the potential spread of weeds, edge effects in surrounding vegetated areas, erosion, dust, intensive light spill, and sedimentation during construction and operation.

Within the 50 metre indirect impact buffer area, there is about 14.40 hectares of native vegetation that is of a similar condition to that of the proposal area ie. scattered patches of native vegetation subject to edge effects and weed incursion. The operation of the proposal would result in edge effects in already fragmented native vegetation within the indirect impact buffer area.

The specific indirect impacts and how they relate to the ecology of the proposal area, along with corresponding mitigation measures are discussed in detail in Table 8-1.

The area associated with indirect impacts on the PCTs and associated habitat surrounding the proposal area has been detailed in Table 7-2. Mitigation measures to minimise identified impacts, are discussed in section 8.

Table 7-2. Area of potential indirect impact

PCT	TEC	Condition identified (Used in BAM-C)	Direct Impact (ha)	Indirect Impact (ha)
849	Yes aligns to the CEEC Cumberland Plain Woodland (BC and EPBC Act)	Medium	3.63	3.89
849	Yes aligns to the CEEC Cumberland Plain Woodland (BC Act)	Low	0.92	0.87
835	Yes aligns to River-Flat Eucalypt Forest (a CEEC under the BC Act and a EEC under the EPBC Act)	Medium	2.84	7.71
835	Yes aligns to River-Flat Eucalypt Forest (a CEEC under the BC Act)	Low	1.52	0.60
1800	Yes aligns to the EEC Swamp Oak Floodplain Forest (BC Act)	Medium	0.47	1.33
Total			9.38	14.40

7.3 Impacts to threatened species

The proposal would have a direct impact to two threatened biodiversity that are regarded as 'species credits' as per the requirements of the BAM: Cumberland Plain Land Snail and Southern Myotis (Table 7-3).

A further 35 threatened fauna species are predicted in the BAM-C to have foraging habitat within the PCTs of the proposal area (Table 4-6). Such species are regarded as 'ecosystem credit' fauna that do not require any further consideration in a BDAR.

In accordance with the BAM, further consideration is required for Southern Myotis and Cumberland Plain Land Snail given the species was recorded during the field survey, and habitat to be impacted fits the species habitat requirements.

As discussed in section 4.2.7 in relation to the Southern Myotis, all PCTs within the proposal area that are associated with the species (as per the TBDC), and within 200 meters of any medium to large permanent creeks, rivers, lakes or other waterways (i.e. with pools/ stretches 3m or wider) (Anderson et al. 2005), are regarded as habitat for the species. The total area of habitat for the Southern Myotis habitat impacted by the proposal is about 6.12 hectares (Figure 9).

As for the Cumberland Plain Land Snail, the area of potential habitat was mapped according to the detailed targeted survey. The area of potential habitat occupies the two populations that were recorded during the field survey as shown on Figure 10.

Table 7-3: Threatened species impacts

Threatened species	Status (BC Act)	Habitat or individuals to be impacted
Southern Myotis	Vulnerable	6.12 ha of potential roosting/foraging habitat
Cumberland Plain Land Snail	Vulnerable	3.40 ha of potential habitat

7.4 Serious and irreversible impacts

The BC Act and the *Local Land Services Act 2013* (LLS Act) imposes various obligations on decision-makers in relation to impacts on biodiversity values that are at risk of Serious and Irreversible Impacts (SAII). These obligations generally require a decision-maker to determine whether the residual impacts of a proposed development on biodiversity values (that is, the impacts that would remain after any proposed avoid or mitigate measures have been implemented) are serious and irreversible.

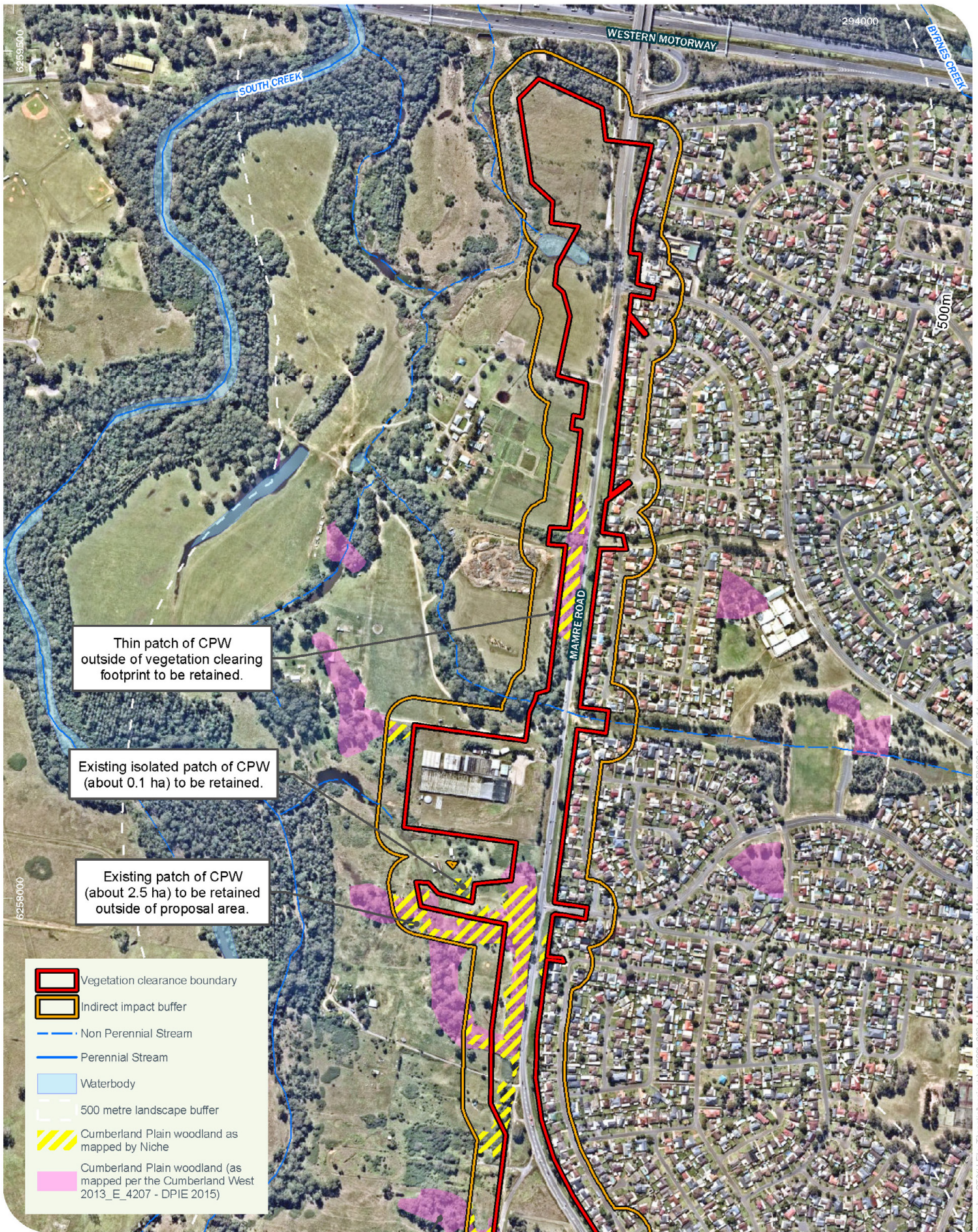
Cumberland Plain Woodland is listed as threatened biodiversity at risk of SAII. As such, the BAM requires the SAII assessment requirements to be addressed in a BDAR, which has been provided in Table 7-4. Figure 11 provides context on the extent of Cumberland Plain Woodland within the locality.

Table 7-4: SAII Assessment for Cumberland Plain Woodland

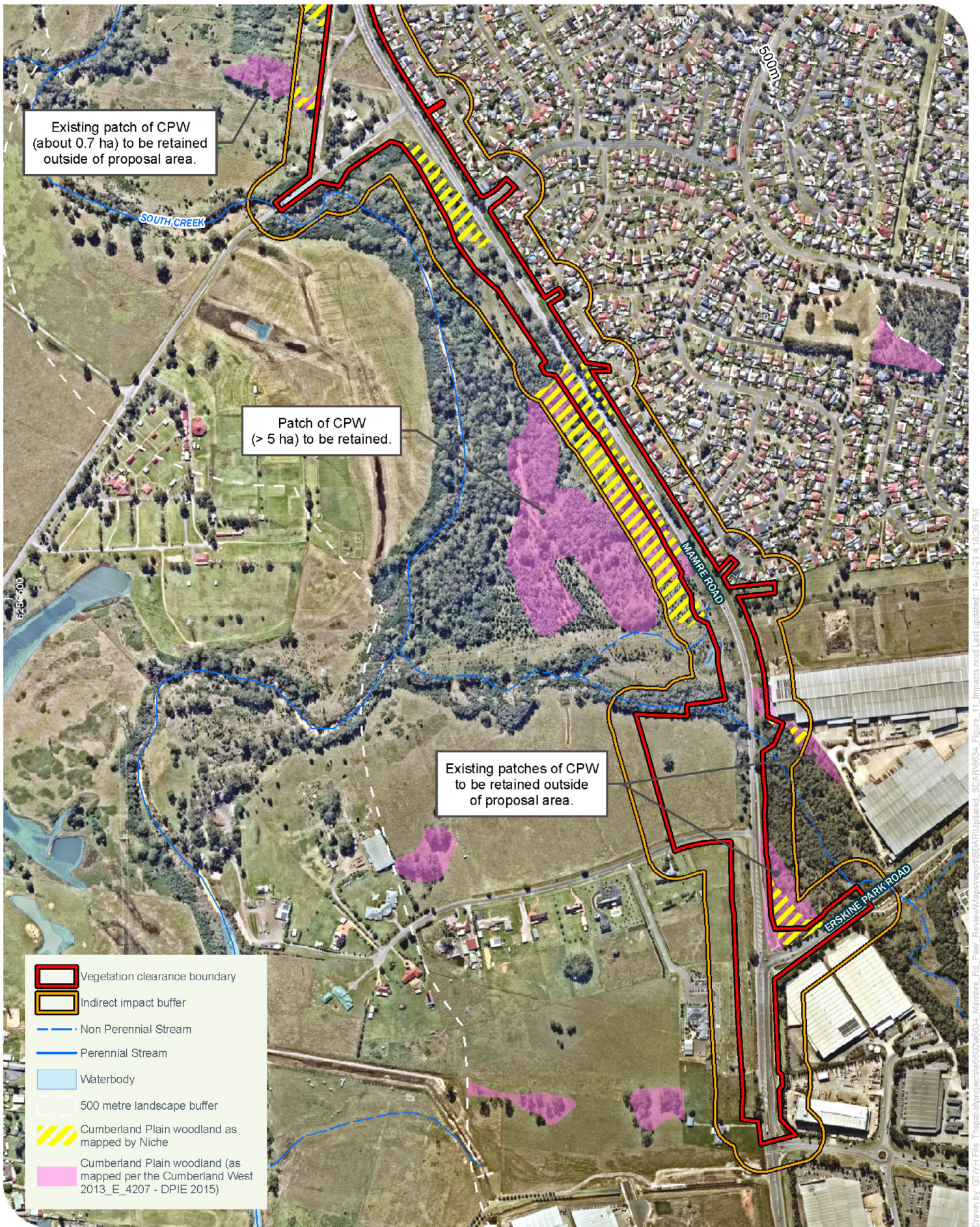
Assessment requirement	Assessment
Impacts of the proposal on the TEC, including: <ol style="list-style-type: none"> 1. Impact on the geographic extent of the TEC <ol style="list-style-type: none"> a. In hectares, and b. As a percentage of the current geographic extent of the TEC in NSW 	<ol style="list-style-type: none"> a. The proposal would remove up to 4.36 ha of Cumberland Plain Woodland TEC. iv. The current extent of the TEC in NSW is 6,500 ha (Bionet Vegetation Classification Database). The direct impact from the proposal represents around 0.06% of the estimated current extent of the TEC in NSW. Within the locality (within 10 km of the proposal) about 79 ha of the TEC has been mapped by OEH (2013). The proposal represents 5% of the TEC within the locality.

Assessment requirement	Assessment
<p>2. The extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes by:</p> <ul 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: iii. 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 iv. estimated maximum dispersal distance for native flora species characteristic of the TEC, and v. 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 	<ul style="list-style-type: none"> i. Within 500 m of the proposal, about 21.09 ha of the TEC is estimated to occur based off OEH (2013) vegetation mapping and aerial interpretation (see Figure 11). <p>The 21.09 ha of TEC occurs as scattered patches ranging in size of about 0.02 ha to greater than 5 ha. Those patches immediately adjacent the proposal area have been shown on Figure 11, along with the corresponding area of each patch that would be retained.</p> <p>The TEC within the proposal area predominately consists of scattered patches along Mamre Road.</p> <p>The vegetation clearing would result in an increased distance between the fragmented patches immediately adjacent to the proposal area, rather than the creation of isolated patches.</p> ii. Clearing under the proposal would create edge effects on the local occurrence of the TEC. Fragmentation of the TEC currently exists as scattered patches within the proposal area. The proposal would increase the distance between the already fragmented patches as shown on Figure 11. iii. As shown on Figure 11 the proposal would result in a greater distance between already fragmented patches of Cumberland Plain Woodland. iv. Characteristic native flora within the patches of Cumberland Plain Woodland in the proposal area is likely to be dispersed by birds, animals, and wind. Each flora species would have differing dispersal distances due to seed. It could be reasonable to assume that the maximum dispersal for some plants is about 300 metres. This would likely be more related to bird dispersal. v. The proposal for the most part, is proposed within a highly fragmented and impacted environment. The Cumberland Plain Woodland in its current form, would likely further decline without sufficient remediation work due to the on-going edge effects.

Assessment requirement	Assessment
<p>vi. iii) describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.</p>	<p>vii. Area of the TEC have been significantly impacted by historic logging, grazing, weed invasion, and feral animal impacts, and as such, no portions of the TEC within the proposal area are in a benchmark condition. Based on the plot surveys within and surrounding the development envelope, two vegetation condition classes were attributed to the TEC:</p> <p>viii. Medium which had a vegetation integrity score of 48.6</p> <p>ix. Low which had a vegetation integrity score of 7.6.</p>
<p>Proposed measures to avoid direct and indirect impacts</p>	<p>Proposed measures to mitigate impacts of the proposal are discussed in Section 8.</p>



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Existing patch of CPW (about 0.7 ha) to be retained outside of proposal area.

Patch of CPW (> 5 ha) to be retained.

Existing patches of CPW to be retained outside of proposal area.

- Vegetation clearance boundary
- Indirect impact buffer
- Non Perennial Stream
- Perennial Stream
- Waterbody
- 500 metre landscape buffer
- Cumberland Plain woodland as mapped by Niche
- Cumberland Plain woodland (as mapped per the Cumberland West 2013_E_4207 - DPIE 2015)

7.5 Prescribed biodiversity impacts

Prescribed biodiversity impacts are impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. This can include impacts on geological features (karst, caves, cliffs etc), human-made structures, connectivity of habitat, water quality and hydrological processes, and vehicle strike.

If human-made structures (e.g. bridges, culverts, abandoned buildings) and non-native vegetation (e.g. camphor laurel trees) provide habitat for threatened species, the assessor must:

- a. provide a description of the type of human-made structure or non-native vegetation habitat
- b. prepare a list of threatened species that use these features as habitat
- c. describe how each threatened species could, or does, use the human-made structure or non-native vegetation as habitat (based on published literature and other reliable sources).

An assessment for each of the relevant prescribed biodiversity impacts have been completed in the following sections.

7.5.1 Human made structures and non-native vegetation

The proposal will result in the upgrade to a number of culverts. As discussed in section 4.2.5, based on field observations, the concrete box girder bridge spanning South Creek appeared to have potential for roosting bats, and has been indicated on Figure 8 as an area of ‘fauna corridor’. The threatened bats that could possibly roost within this structure has been summarised in Table 7-5, and include: Southern Myotis, Large Bentwing-bat and Little Bentwing-bat.

To provide further mitigation towards the potential for roosting habitat to be present, we have provided recommendations in section 8.

Table 7-5: Potential impacts on species and ecological communities associated with human-made structures and non-native vegetation

Species or ecological community	Human-made structures and/or non-native vegetation with potential to be habitat	Nature, extent and duration of short and long-term impacts due to removal of structures and/or non-native vegetation	Importance within the bioregion of the habitat to these species or ecological communities	Consequences of the impacts for the local and bioregional persistence
Southern Myotis and other threatened culvert roosting bats (such as Large Bentwing-bat and Little Bentwing-bat)	Culverts within the subject area were considered potential habitat for roosting bats at different times of the year. Removal of culverts is listed as a prescribed impact and therefore, will require further consideration in accordance with the BAM.	Upgrade of the existing culverts which may displace roosting habitat if present. The potential impact may occur during the construction phase of the culverts.	Low- artificial habitat in the form of culverts and other man-made structures are prevalent throughout Greater Sydney.	Low – minor impact on a regional scale

7.5.2 Connectivity and movement

The proposal would result in the removal of native vegetation along the existing Mamre Road corridor (referred to as the vegetation clearance boundary) (Figure 3). The removal of native vegetation along a tributary of South Creek to the far south of the proposal area would result in an increased distance between two patches of native vegetation on the east and west of Mamre Road (see Figure 8). The two patches are currently separated by about 20 metres. The proposal would result in an increase of 80 metres between the two patches. The potential impacts to this corridor are discussed in the Table below.

Table 7-6: Potential impacts associated with loss of connectivity

Area of connectivity	Species	Movement patterns key to the life cycle of the species	Nature, extent and duration of short and long-term impacts to connectivity	Importance of the area of connectivity within the bioregion and to the lifecycle of the species	Consequences of the impacts for the local and bioregional persistence
<p>Fauna corridor identified on Figure 8.</p> <p>The distance between the two patches of vegetation (east and west of Mamre Road) is currently about 20 metres. The proposal would result in an increase in the distance between the two patches by about 100 metres.</p>	<p>All fauna species</p>	<p>The increased distance between the two patches (from 20 metres to 100 metres) may result in some degree of obstruction of fauna movement along this portion of the Mamre Road.</p> <p>The eastern patch is approximately five hectares in size, whilst the western patch is greater than 100 hectares.</p> <p>Given the size of the eastern patch, it is unlikely to provided important habitat for most threatened fauna (such as threatened mammals, birds and microbats). However such species may use this area on occasion for foraging.</p> <p>The increase in distance is unlikely to impact upon species such as Microbats and birds given their mobility.</p> <p>The increased distance may impact upon the movement of mammals through this portion of the South Creek tributary, that may use the eastern patch for foraging.</p> <p>Molluscs, such as the Cumberland Plain Land Snail are unlikely be significantly impacted by the increased distance. The existing distance separated by Mamre Road is likely to be an existing barrier to connect the east and west populations of the species (see Figure 8 for population locations).</p>	<p>Permanent increase in distance between two patches of native vegetation along a tributary of South Creek.</p>	<p>All riparian corridors should be given importance to facilitate fauna movement throughout the region.</p> <p>The increased distance is unlikely to impact the lifecycle of mobile species (such as microbats and birds).</p> <p>The barrier may result in movement for some non-threatened mammals (such as Eastern Pygmy possums) across this area. However, the reliance on the five hectare patch of native vegetation on the eastern side of Mamre Road for species survival and important lifecycle is unlikely.</p> <p>The impact on the Cumberland Plain Land Snail population that occurs within this area has been offset (section 9).</p>	<p>The increased distance is unlikely to substantially impact upon threatened biodiversity, based on the following:</p> <ul style="list-style-type: none"> - the eastern patch is about 5 hectares in size and is unlikely to contain important limited habitat (eg. Bushrock, large tree hollows, stags, caves etc.), - lack of threatened species (mammals, birds, reptiles, flora) records within this area. - Cumberland Plain Land Snail populations are already fragmented.

7.5.3 Water quality and hydrology

The potential changes to hydrology and water quality have been addressed in Aurecon (2021) *Water quality and soil impact assessment*. There is potential for erosion to occur during construction leading to sedimentation and water quality impacts in South Creek, and the potential for an increase in pollutant load due to an increase in pavement footprint. The potential impacts to PCTs and species that utilise South Creek are discussed in the Table below.

Table 7-7: Potential impacts to water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

Species or ecological communities	Waterbodies impacted	Nature, extent and duration of short and long-term impacts on water quality and hydrological process	Nature, extent and duration of short and long-term impacts on habitat and life cycle	Importance within the bioregion of the waterbody or hydrological process	Consequences of the impacts for the local and bioregional persistence
PCTs and associated fauna habitat that occur next adjacent to South Creek (towards far South of proposal area)	South Creek	<p>Impacts to water quality are discussed in Aurecon (2021).</p> <p>South Creek is currently subject to a range of pollutants and pressures that have reduced water quality.</p> <p>The proposal would result in a minor, permanent impact to water quality within South Creek through the construction of drainage works/culverts and trenches. The on-going operation of the road would also result in an increase in pollutants from surface water runoff. Mitigation measures are proposed to reduce the impact.</p>	<p>Unlikely to result in any long-term impacts to biodiversity lifecycle. The proposal is unlikely to result in such an impact to South Creek, that would substantially change any threatened flora or fauna or TEC.</p> <p>No threatened aquatic species are likely to occur in South Creek.</p>	<p>South Creek is an important waterbody in the Hawkesbury Nepean region. The impact to South Creek however, would be marginal, and would not an important hydrological process from being significantly altered.</p>	<p>Low – unlikely to result in any substantial change to local and bioregional significant.</p>

7.5.4 Vehicle strike

Given the proposal area is located immediately adjacent to some patches of native vegetation (Figure 4 and Figure 5) there is the potential for vehicle interactions with fauna. The likelihood and assessment of the potential impacts are provided in Table 7-8.

Table 7-8: Potential impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC

Species at risk of vehicle strike	Likelihood of vehicle strike	Estimate vehicle strike rates	Consequences of the impacts for the local and bioregional persistence of the species
All threatened fauna species with moderate to high likelihood to occur.	<p>Low. The proposal area generally occurs within a cleared landscape with native vegetation scattered across the existing road corridor.</p> <p>The key area for fauna movement is to the far south of the proposal area (Figure 8). The likelihood of fauna interactions within this portion would be greater than the rest of the proposal area. A mitigation measure proposed is to install a new fence along the northern boundary of the Luddenham BioBank site to reflect the proposal area. The remaining fence of the BioBank site would be retained.</p>	<p>It is estimated that vehicle strike rates would be low. This is supported by only a few (<5) historic records of vehicle collision along Mamre Road within the proposal area, and within 5km to the south of the proposal area (mainly to kangaroos/wallabies) as reported on Bionet.</p> <p>Overall, the fauna survey did not detect a high abundance of fauna utilising the general proposal area.</p>	<p>The proposal has the potential to result in fauna vehicle strikes. However, it seems unlikely that the proposal would result in a significant increase in vehicle interactions with native fauna, such that it would significantly impact upon local populations.</p>

7.6 Aquatic impacts

The proposal has been designed to minimise environmental impacts to aquatic habitats where possible, with the majority of works being undertaken away from watercourses.

As discussed in section 4.3.2, the proposal will not have an impact on habitat suitable for the Macquarie Perch, Australian Grayling or any other threatened fish.

Impacts as a result of construction and operation have been detailed in the Aurecon (2021) *Water quality and soil impact assessment*. The assessment concluded that the proposed channel works would permanently alter the bed and bank of watercourses within proposal area. There is potential for erosion to occur during construction leading to sedimentation and water quality impacts in the watercourse until the works area is suitably stabilised, however mitigation measures are proposed to reduce such impacts (section 8.1).

The proposal has the potential to increase the pollutant load being released from the proposal area, due to the proposed increase in pavement footprint (Aurecon 2021).

The key pollutants contained in road runoff include:

- suspended solids due to pavement wear, tyre wear, atmospheric deposition and deposition from vehicles
- heavy metals bound to dust particles washed off pavement surface
- oil and grease and other hydrocarbons deposited by vehicles
- nutrients due to atmospheric deposition.

The increase in pollutant load could potentially result in water quality impacts such as sedimentation, reduced water clarity, increased toxicant and nutrient concentrations and lower dissolved oxygen levels within the local tributaries and South Creek. Such impacts are determined in the Aurecon (2021) assessment to be permanent and minor.

Regardless of potential impacts, the proposal is unlikely to have a significant impact on any threatened species, communities or populations listed on the FM Act given the temporary nature of the construction works and the mitigation measures that would be employed. The proposal is also unlikely to result in a substantial long-term impact to mapped Key Fish Habitat along South Creek. Additionally, fish passage will be maintained in accordance with relevant guidelines (ie. DPI 2013).

A permit under the Part 7 of the FM Act may be required for the proposal given the works have the potential obstruct the free passage of fish whether permanently or temporarily in TYPE 1 habitats.

7.7 Groundwater dependent ecosystems

Potential impacts to groundwater have been assessed in the Aurecon (2021) *Water quality and soil impact assessment* for the proposal. The assessment concludes 'impacts to terrestrial and aquatic groundwater dependant ecosystems within proximity to the proposal as a result of changes in groundwater level are likely to be minor' (Aurecon 2021). This conclusion is attributed to the following:

- Groundwater has been intercepted at between 0.7 metres and 4.9 metres below ground level (m BGL) within the proposal area. Earthworks associated with road construction are generally likely to be shallow and include shaping of the upper soil profile so groundwater is unlikely to be intercepted during most construction activities.
- Slightly deeper excavations may be required for utility and service trenches, construction of drainage infrastructure and piling for construction of the noise walls. There is potential for some minor volumes of groundwater to enter trenches and drainage works excavations however these excavations would be temporary and localised and given the low permeability of the local clay soils, inflow volumes are likely to be low.
- Similarly piling works are only likely to require minor volumes of groundwater to be extracted. Where groundwater is intercepted, the quality of the groundwater must be considered during groundwater dewatering, management and release.
- Large volumes of dewatering or groundwater extraction is unlikely to be required, so groundwater flows and quality are unlikely to be significantly impacted by the proposed earthworks (Aurecon 2021).

7.8 Areas of Outstanding Biodiversity Value

Areas of Outstanding Biodiversity Value are special areas with irreplaceable biodiversity values that are important to the whole of New South Wales, Australia or globally.

The BC Act gives the Minister for Energy and Environment (E&E) the power to declare Areas of Outstanding Biodiversity Value.

Area of Outstanding Biodiversity Value declarations in New South Wales include:

- Gould's Petrel – critical habitat declaration
- Little penguin population in Sydney's North Harbour – critical habitat declaration
- Mitchell's Rainforest Snail in Stotts Island Nature Reserve – critical habitat declaration

- Wollemi Pine – critical habitat declaration

None of these areas would be impacted by the proposal.

7.9 Matters of National Environmental Significance

Impacts to threatened biodiversity listed on the EPBC Act have been avoided where practical through the design of the proposal (section 6) and will be further reduced through a series of mitigation measures discussed in section 8.

The unavoidable impacts to Commonwealth threatened biodiversity include the following:

- Direct impact to about 3.63 hectares of Cumberland Plain Woodland, which meets the Commonwealth CEEC definition
- Direct impact to about 2.84 hectares of River-Flat Eucalypt Forest, which meets the Commonwealth CEEC definition.
- Direct impacts to about 9.38 hectares of potential habitat for the Yellow Wagtail.

Assessments of Significance for the above threatened biodiversity were completed, and have been provided in Appendix E. The results of the Assessments of Significance conclude that the proposal may have a significant impact to Cumberland Plain Woodland. The proposal is unlikely to have a significant impact on the remaining threatened biodiversity listed under the EPBC Act.

Whilst it is not a requirement for the proposal to provide a specific offset for significantly impacted Commonwealth matters (1.4.3), it should be noted that the proposal will result in a biodiversity offset for Cumberland Plain Woodland and River-flat Eucalypt Forest (section 9), which in turn will ensure the in-perpetuity management of the EPBC Act listed TECs.

7.10 Cumulative impacts

The potential for cumulative impacts due to the proposal has been considered. The proposal occurs within an area identified as the Western Sydney Employment Area, and would provide transportation connections to the Western Sydney Employment Area. Other planned and potential infrastructure developments in the locality include:

- M12 Motorway: A new dual-carriageway motorway to connect the M7 Motorway with the Western Sydney Airport and The Northern Road, which would pass over Mamre Road. Construction expected 2022 – 2025.
- Sydney Metro Western Sydney Airport: Construction and operation of a new metro railway around 23 kilometres in length between the existing Sydney Trains suburban rail network at St Marys in the north and the Western Sydney Aerotropolis Core precinct in the south, via Western Sydney airport. Construction expected 2021 – 2026.
- Western Sydney Airport: Construction of Western Sydney airport to provide additional aviation capacity in Sydney. At the time of writing, construction was in progress, due for completion in 2026.
- M4 Roper Road Westbound On Ramp: Construction and operation of a new west facing ramp, providing direct access onto the M4 Motorway from traffic travelling north from St Clair. Construction expected 2021 – 2022.
- M4 Smart Motorways: Introduction of intelligent technology to the M4 Motorway between Pitt Street, Parramatta and Mulgoa Road, Penrith. Completion expected in 2021.
- Western Sydney Employment Area: Western Sydney Employment Area (WSEA) was developed to provide businesses with land for industrial and employment purposes, close to major road transport corridors. The southern portion of the proposal area is located within the Erskine Park Employment Lands precinct, Mamre West precinct and Broader Western Sydney Employment Area precinct of the WSEA.
- Altis Warehouse and Logistics Hub: Altis Property Partners propose to construct and operate a warehouse and logistics hub in Orchard Hills. Construction beginning in 2021.

- Upper South Creek Advanced Water Recycling Centre: Sydney Water is planning to build and operate a wastewater treatment plant in Western Sydney. Construction expected 2022 – 2025.

The Western Sydney Aerotropolis occurs about 10 kilometres to the south of the proposal area, and has undergone extensive biodiversity survey. The Western Sydney Airport EIS, prepared for the Department of Infrastructure and Regional Development (GHD, 2016) has identified the following impacts to biodiversity:

- Construction for stage 1 development would impact about 318.5 hectares of native vegetation, including 104.9 hectares of Cumberland Plain Woodland and 42.1 hectares of River-flat Eucalypt Forest
- Removal of habitat for threatened flora, including *Pultenaea parviflora*, *Cynanchum elegans*, *Pimelea spicata*, *Grevillea parviflora subsp. parviflora* and *Thesium australe*.
- Removal of habitat for a range of threatened fauna, including Grey-headed Flying Fox, Swift Parrot and Cumberland Plain Snail.
- Operation for stage 1 development would pose a risk of fauna strike from contact with aircraft and ground transportation vehicles.

The proposal will marginally increase the amount of native vegetation and habitat removal (about 9.38 hectares) within the wider locality.

The proposal area is located within land identified in the proposed Cumberland Plain Conservation Plan (DPIE 2020d). The Cumberland Plain Conservation Plan is one of the largest strategic conservation plans to be undertaken in Australia and is the first strategic biodiversity certification to be undertaken under the BC Act. It is currently in draft form, and awaiting formal approval.

The Draft Cumberland Plain Conservation Plan aims to protect TEC that would be impacted by development in the nominated development areas. The Plan would result in 4,795 hectares being zoned for environmental conservation (DPIE 2020e), which would include conservation sites for the TECs impacted by the proposal (River-flat Eucalypt Forest, Cumberland Plain Woodland and Swamp Oak Floodplain), and associated threatened species habitat (eg. Southern Myotis habitat).

8 Mitigation

8.1 Mitigation measures

The specific indirect impacts and how they relate to the ecology of the proposal area, along with corresponding mitigation measures are discussed in detail in Table 8-1. The mitigation measures provided would be consistent with industry best practice to ensure that mitigation is effective. Monitoring of the effectiveness of the mitigation measures would be incorporated as part of the management actions associated with the proposal.

Construction and operation of the proposal will be undertaken in accordance with TfNSW's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RMS, 2011):

- Guide 1. Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
- Guide 2. Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
- Guide 3. Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
- Guide 4. Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
- Guide 5. Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
- Guide 6. Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
- Guide 7. Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects.
- Guide 9. Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity
- Guide 10. Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects

It is recommended that a project specific Flora and Fauna Management Plan (FFMP) be prepared to reflect biodiversity management measures associated with the proposal in order to protect and manage important biodiversity values, and discusses key commitments relating to threatened species management, pest and weed management, and site hygiene practices.

The FFMP would be consistent with the current TfNSW Biodiversity Guidelines and include specific protocols dealing with any potential interaction between the proposal activities and threatened flora or fauna species during the construction and operational phase.

The FFMP will include directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the project and protocols for reporting and managing any unforeseen threatened species occurrences within the proposal area.

In summary, mitigation measures to be undertaken during construction and post construction include:

Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposal area.

Signposting will be used to inform project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.

Employee Education and General Environmental Controls

Employees and contractors would be educated on and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with the proposal:

- Minimise dust generation by minimising the extent and time that bare sand is exposed and by appropriate sand suppression.
- Procedures for the management of hydrocarbon and/or chemical spills including the requirements for vehicles to carry spill kits.
- Ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going project discussions.
- Management and removal of all rubbish from the site.

Microbat Pre-construction Protocol

A microbat management plan is recommended. Prior to demolition, the culverts should be surveyed for the presence of threatened bats. Ecologists are to visually inspect features (culverts, bridges etc) using a handheld torch, binoculars, digital zoom camera, a handheld ultrasonic device to identify any microbat roost points and any direct and/or indirect signs of occupancy (i.e., physical presence, guano, staining, ammonia-like odours, evidence of roost points, exit/entry points). If threatened bats are recorded, further assessment by a microbat expert and preparation of a management plan would be required to allow the safe demolition of the culvert. If exclusion of microbats has been determined, then demolition can occur at any time of the year.

After the pre-demolition inspection, if roosting habitat is likely, TfNSW would assign a microbat expert to recommend habitat replacement options/exclusion measure options (if required) to be installed at least a month prior to works.

Prior to construction/demolition works, a microbat expert is to be engaged to supervise the demolition of culverts and bridge infrastructure that has been identified as potential roosting habitat during the pre-demolition inspection.

In regard to the removal of hollow-bearing trees, these would be checked and identified fauna relocated as per the TfNSW Biodiversity guidelines.

Any fauna displaced during clearing are to be captured where possible and relocated to pre-planned areas (microbats to be captured and handled only by a vaccinated and qualified handler).

In an event that fauna are injured works, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

Vegetation Clearance Protocol

The FFMP will refer to the current TfNSW Vegetation Clearing Protocol, which in summary includes the following:

- Prior to clearing of native vegetation, ecologists are to survey for ground dwelling fauna and to remove any fauna/ fauna habitats to adjacent areas that would not be further disturbed.
- Prior to clearing of remnant hollow-bearing trees or habitat trees, ecologists are to be engaged to supervise felling. All hollow-bearing trees that are accessible safely from the ground are to be checked and identified fauna relocated. Hollows higher up and not accessible from the ground are to be identified and trees felled gently by an excavator or dozer and left overnight to allow fauna to relocate.
- Any fauna displaced during clearing are to be captured where possible and relocated to pre-planned areas (fauna to be captured and handled only by personnel trained to do so).
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

Table 8-1: Mitigation measures

Impact	Mitigation measure	Timing and duration	Likely efficacy	Residual impacts anticipated	Responsibility
Removal of native vegetation	Measures to further avoid and minimise the area of native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Detailed design phase	Effective in reducing area of impact	Indirect impacts to remaining patches are discussed in section 7.2.	TfNSW
	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Prior to construction	Effective	Unlikely	Ecologist / Contractor
	Develop and implement a Flora and Fauna Management Plan as part of the Construction Environmental Management Plan (CEMP).	Prior to construction	Proven	Unlikely	TfNSW/ Ecologist
	Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	Unlikely	Contractor / TfNSW
	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Post construction	Effective	Unlikely	Contractor
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	Unlikely	Contractor

Impact	Mitigation measure	Timing and duration	Likely efficacy	Residual impacts anticipated	Responsibility
Removal of threatened species habitat and habitat features	Habitat removal minimised through detailed design.	Detailed design	Effective	Avoidance discussed in section 6	TfNSW
	Develop and implement a Flora and Fauna Management Plan as part of the CEMP.	Prior to construction	Proven	Unlikely	TfNSW/ Ecologist
	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	During construction	Effective	Unlikely	Ecologist
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	During construction	Effective	Unlikely	Contractor
	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	During construction	Proven	Unlikely	Contractor
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	Unlikely	Contractor
Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	During construction	Proven	Unlikely	Contractor / Ecologist
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal area.	During construction	Proven	Unlikely	TfNSW / Contractor

Impact	Mitigation measure	Timing and duration	Likely efficacy	Residual impacts anticipated	Responsibility
Changes to hydrology	Changes to existing surface water flows would be minimised through detailed design.	Detailed design	Effective	Unlikely – hydrology impacts assessed in Aurecon (2021)	Design team / TfNSW
Indirect impacts on native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	Unlikely	Contractor
Injury and mortality of fauna	Fauna will be managed in accordance with <i>Guide 9: Fauna handling</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	Unlikely	Contractor / Ecologist
Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	Unlikely	Contractor / TfNSW
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	Unlikely	All contractors
Noise, light and vibration	Shading and artificial light impacts minimised through detailed design, particularly adjacent to the BA408 Luddenham BioBank site.	Detailed design	Effective	Unlikely – road lighting and noise currently operating.	Design team
Impacts to habitat in human made structures	Microbat pre-demolition inspections, toolbox talks, ecological supervision and habitat replacement options.	Detailed design and during construction	Effective	Unlikely if appropriately mitigated.	Contractor / ecologist

Impact	Mitigation measure	Timing and duration	Likely efficacy	Residual impacts anticipated	Responsibility
Vehicle strike	<p>It is recommended that TfNSW monitor road kills along Mamre Road.</p> <p>The northern portion of the Luddenham BioBank site would require the existing fence to be removed to account for the proposal area. A new fence is to be installed at the northern portion of Luddenham BioBank site to assist in minimising fauna movement across Mamre Road.</p>	Detailed design	Effective	Unlikely	Design team
Aquatic impacts	<p>Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> and Section 3.3.2 Standard precautions and mitigation measures of the Policy and <i>guidelines for fish habitat conservation and management Update 2013 (DPIE 2013)</i>.</p> <p>Culverts will be installed in accordance with the DPIE (2013) guidelines.</p> <p>Implement and regularly maintain erosion and sediment controls for the duration of construction and landscaping works as per Landcom (2004), which will be detailed in a Soil and Water Management Plan.</p>	During construction	Effective	Unlikely	Design team and construction

9 Offsetting

9.1 Ecosystem credits

The BAM identifies the BAM-C as the appropriate tool for quantifying the offsets required, which is expressed as numbers of ecosystem and species credits. A calculation of the nature and extent of biodiversity credits required due to ecological impacts associated with the proposal has been undertaken using the BAM-C.

The results of the BAM-C, ecosystem offset credit requirements, including current, future and change in vegetation integrity scores are shown in Table 9-1.

Impacts to native vegetation communities within the development site generate a requirement for 242 ecosystem credits. The 242 ecosystem credits also cover the credit requirement for ecosystem credit species. The full BAM-C biodiversity credit report is provided in Annexure F.

Table 9-1: Ecosystem credits

PCT	Vegetation zone	Impact area (ha)	Current Vegetation Integrity score	Future Vegetation Integrity score	Change in Vegetation Integrity Score	Biodiversity risk weighting	Required credits
PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	835_Moderate	2.8	72.4	0	72.4	2	103
	835_Low	1.5	27.6	0	27.6	2	21
PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	849_Moderate	3.6	48.6	0	48.6	2.5	110
	849_Low	0.92	7.6	0	7.6	2.5	0
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.	1800_Moderate	0.47	36.1	0	36.1	2	8
Total							242

9.2 Species credits

The results of the BAM-C species offset credit requirements are shown in Table 9-2. Threatened species identified or assumed to be present within the development site and likely to be impacted by the proposal generate a requirement for a total of 246 species credits. The full BAM-C biodiversity credit report is provided in Annexure F.

Table 9-2: Species credits required

Species	Habitat impacted	Credits required
Southern Myotis	6.12	160
Cumberland Plain Land Snail	3.40	86

9.3 Credits matching the ‘like for like’ and credit variation rules

The BAM allows for certain PCT’s to be offset with other PCTs where the ‘like for like’ rule can be met. The BAM also puts restrictions on where credits can be sourced and whether hollow-bearing trees must be present at the offset site.

Where ‘like for like’ credits cannot be sourced, the BAM also allows for other credit types to be sourced subject to the variation rules contained in the BC Regulations.

The like-for-like and variation offset options for ecosystem credits are listed in Table 9-3.

Table 9-3. ‘Like for like’ and variation offset options for ecosystem credits

PCT	Hollow bearing trees required	PCTs matching ‘like for like’ requirements	Variation options
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions / PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	No	686, 828, 835, 839, 941, 971, 1064, 1108, 1109, 1212, 1228, 1232, 1293, 1318, 1326, 1386, 1504, 1522, 1556, 1594, 1618, 1646, 1648, 1720, 1794.	42, 835, 1232.
Cumberland Plain Woodland in the Sydney Basin Bioregion /PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	No	849, 850	201, 266, 277, 282, 303, 312, 654, 677, 680, 705, 849, 1191, 1295, 1326, 1330, 1332
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions / PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.	No	915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808	1064, 1106, 1227, 1230, 1232, 1234, 1235, 1318, 1386, 1716, 1717, 1718, 1720, 1723, 1727, 1728, 1730, 1731.

9.4 Offsetting strategy

To satisfy the offset requirement, TfNSW will pay the offset requirement into the Biodiversity Conservation Fund. The Biodiversity Conservation Trust (BCT) will source the required biodiversity offset, which in turn will contribute to in-perpetuity protection and enhancement of the TECs, Cumberland Plain Land Snail and the Southern Myotis.

10 Conclusion

TfNSW have aimed to avoid and minimise environmental impacts from the proposal as far as practical, and have proposed a series of mitigation measures to manage potential indirect impacts from the proposal.

The unavoidable impacts of the proposal on ecological values includes the clearing of 9.38 ha of vegetation regarded as 'native vegetation,' as defined in the BAM. Associated fauna habitat would also be directly impacted.

Through the application of the BAM, associated guidelines and the BAM-C, the following biodiversity credit offset is required for the proposal:

- 124 credits for PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- 110 credits for PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- 8 credits for PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
- 160 credits for Southern Myotis
- 86 credits for Cumberland Plain Land Snail.

Assessments of significance under the EPBC Act were also completed for threatened biodiversity (Cumberland Plain Woodland, River-flat Eucalypt Forest, Yellow Wagtail, and Grey-headed Flying-fox) impacted by the proposal. Given the proposal is being undertaken by TfNSW under Division 5.1 of the EP&A Act, the strategic assessment applies, and no further Referral under the Commonwealth is required.

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Annexure A

Habitat suitability assessment table

A list of subject threatened flora and fauna and threatened ecological communities within the locality (10 km radius) was determined from database searches. The list of potentially impacted species is determined from consideration of this list. In order to adequately determine the relevant level of assessment to apply to potentially affected species, further analysis of the likelihood of those species occurring within the proposal area was completed.

Five categories for 'likelihood of occurrence' were attributed to species after consideration of criteria such as known records, presence or absence of important habitat features on the proposal area, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further in formal assessments of significance (EPBC Act) were those in the 'Known', 'High' or 'Moderate' categories and where adverse impacts for the species could reasonably occur from the development. Species listed as a 'Low' or 'None' likelihood of occurrence are those for which there is limited or no habitat present within the proposal area.

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the proposal area.	The species was observed within the proposal area.
High	It is likely that a species inhabits or utilises habitat within the proposal area.	It is likely that a species inhabits or utilises habitat within the proposal area.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the proposal area.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the proposal area.
Low	It is unlikely that the species inhabits the proposal area.	It is unlikely that the species inhabits the proposal area. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its on-going local existence.
None	The habitat within the proposal area is unsuitable for the species.	The habitat within the proposal area is unsuitable for the species.

Likelihood of occurrence – Threatened flora and fauna

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
Fish							
<i>Macquaria australasica</i>	Macquarie Perch	E	E	Species or species' habitat may occur within 10km (DAWE 2021a)	<p>The Macquarie Perch is known only from scattered localities in the cool upper reaches of the Murray-Darling system of New South Wales, including the Hawkesbury-Nepean and Shoalhaven catchments, Victoria and the Australian Capital Territory. Also found in man-made lakes on the NSW coast. The species inhabits cool, clear freshwaters of rivers with deep holes and shallow riffles. They are also found in lakes and reservoirs, where adults aggregate in small shoals during the spawning season.</p> <p>The proposal area does not contain suitable permanent watercourses for the species.</p>	None – habitat within the tributaries that cross the proposal area are not suitable given lack of permanent water.	N/A
<i>Prototroctes maraena</i>	Australian Grayling	-	V	Species or species' habitat may occur within 10km (DAWE 2021a)	<p>The Australian Grayling occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons, from Shoalhaven River in NSW to Ewan Ponds in South Australia.</p> <p>The proposal area does not contain suitable permanent watercourses for the species.</p>	Low – shallow and highly disturbed drainage lines and farm dams present do not provide suitable habitat for this species.	N/A
Amphibians							
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	16 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	<p>Since 1990 there have been about 50 recorded locations of Green and Golden Bell Frog in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. The species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimal habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. Some sites the species has been recorded in, occur in highly disturbed areas.</p>	<p>Low – Targeted survey confirmed the species is unlikely to use the proposal area.</p> <p>The habitat along the tributaries of South Creek that occur within the proposal area are less than ideal for the Green and Golden Bell Frog.</p>	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Litoria raniformis</i>	Southern Bell Frog	E	V	Species or species' habitat may occur within 10km (DAWE 2021a)	Currently, the Growling Grass Frog is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. A few yet unconfirmed records have also been made in the Murray Irrigation Area in recent years. The species is usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat. Breeding occurs during the warmer months and is triggered by flooding or a significant rise in water levels. The species has been known to breed anytime from early spring through to late summer/early autumn.	None –The species has not been recorded within 10 km of the proposal area. The proposal area is also not located within an area of known distribution (Bionet).	Species
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Species or species' habitat likely to occur within 10km (DAWE 2021a)	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. It is found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	None – no suitable habitat is present.	N/A
Moluscs							
<i>Meridolum comeovirens</i>	Cumberland Plain Land Snail	E	-	529 records within 10km (DPIE 2021a)	Lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. The species primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Known – recorded in proposal area by Aurecon in September 2020.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Pommerhelix duralensis</i>	Dural Land Snail	E	E	1 record within 10km (DPIE 2021a)	The Dural Land Snail is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species is definitely found within the Local Government Areas of The Hills Shire, Hawkesbury Shire and Hornsby Shire. Records from the Blue Mountains City, Penrith City and Parramatta City may represent this species. Occurrence in Wollondilly Shire is considered unlikely in light of current knowledge. It favours sheltering under rocks or inside curled-up bark, it does not burrow nor climb.	Low – The proposal area does contain habitat that fits the description for the species, however the Dural Land Snail was not recorded during extensive targeted survey.	N/A
Birds							
<i>Actitis hypoleucos</i>	Common Sandpiper	-	M, MA, C, J, K	1 record within 10km, last recorded 1981 (DPIE 2021a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Low – farm dams are present immediately adjacent to the proposal area, however no preferred types such as mangroves, or rivers with pebbles occur. Unlikely to be present.	N/A
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E,M	18 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. The proposal area however, does not occur within the 'important Regent Honeyeater' map as per the BAM Important Areas Map. Therefore the 'species credit' component associated with Regent Honeyeater breeding habitat is not triggered.	Species/ ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	3 records within 10km (DPIE 2021a); Species or species' habitat likely to occur within 10km (DAWE 2021a)	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines.	Low – no nests found in proposal area during field survey. May fly over proposal area on occasion, however has a low likelihood of presence.	N/A
<i>Ardea ibis</i>	Cattle Egret	-	M	Species or species' habitat may occur within 10km (DAWE 2021a)	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor.	Known – recorded in proposal area by Niche ecologists in April 2021.	N/A
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	28 records within 10km (DPIE 2021a)	The Dusky Woodswallow is widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Although Dusky Woodswallows have large home ranges, individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Dusky Woodswallows prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (<i>Manorina melanocephala</i>) is a significant threat to this species.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Species or species' habitat known to occur within 10km (DAWE 2021a)	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. The Species favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.), it hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. The species may construct feeding platforms over deeper water from reeds trampled by the bird; platforms are often littered with prey remains.	Low – Farm dams are present immediately adjacent to proposal area however, vegetation is not dense and tall and no records occur nearby.	N/A
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	2 records within 10km, last recorded 1996 (DPIE 2021a)	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. It inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber, it's diet consists of insects and small vertebrates, such as frogs, lizards and snakes. It is largely nocturnal, being especially active on moonlit nights and nests on the ground in a scrape or small bare patch.	Low – limited areas of open woodlands with fallen timber occur within the proposal area. The species was not recorded during field surveys, nor has it been recorded within immediately surrounding area. The species is unlikely to use the proposal area as habitat.	Species
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	M, MA	1 record within 10km (DPIE 2021a)	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	Low – the proposal area does not contain extensive areas of wetland habitat. There are a number of farm dams and small areas consisting of native flora that prefer wetter environments, that occur immediately adjacent to the proposal area. It is however, unlikely that such habitat presents important foraging and breeding habitat for the species.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE, M, MA	Species or species' habitat may occur within 10km (DAWE 2021a)	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland. Northern hemisphere breeding.	Dual credit species in the TBDC. Dual credit species in the TBDC. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present, however it should be noted that the proposal area does not contain preferred habitat (such as freshwater wetlands and estuaries not in proposal area). It therefore has a low likelihood of occurrence.	Species/ecosystem (SAIL breeding/foraging)
<i>Calidris melanotos</i>	Pectoral Sandpiper	-	M, MA	Species or species' habitat may occur within 10km (DAWE 2021a)	Prefers shallow fresh to saline wetlands, found at coastal lagoons, estuaries, bays, swamps, inundated grasslands, saltmarshes and artificial wetlands. Northern hemisphere breeding.	Low – habitat preferences such as freshwater wetlands and estuaries not in proposal area.	N/A
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	1 record within 10km (DPIE 2021a)	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	Dual credit species in the TBDC. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present. Breeding habitat (which constitutes the 'species credit' component does not occur within the proposal area given hollows are not of suitable size as per the TBDC.	Species/ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-	2 records within 10km (DPIE 2021a)	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. It inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, <i>Allocasuarina diminuta</i> , and <i>A. gymnanthera</i> . Belah is also utilised and may be a critical food source for some populations. The species is dependent on large hollow-bearing eucalypts for nest sites.	Dual credit species in the TBDC. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present. Breeding habitat (which constitutes the 'species credit' component does not occur within the proposal area given hollows are not of suitable size as per the TBDC.	Species/ ecosystem
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	19 records within 10km (DPIE 2021a)	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies, typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.	Ecosystem
<i>Circus assimilis</i>	Spotted Harrier	V	-	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. The species occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	1 record within 10km (DPIE 2021a)	The western boundary of the range of the Brown Treecreeper runs about through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper which then occupies the remaining parts of the state. The species is often found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.	Ecosystem
<i>Cuculus optatus</i>	Oriental Cuckoo	-	M, MA	Species or species' habitat known to occur within 10km (DAWE 2021a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	Low – habitat preferences not in proposal area.	N/A
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	40 records within 10km (DPIE 2021a)	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.	Ecosystem
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	2 records within 10km (DPIE 2021a)	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Falco hypoleucos</i>	Grey Falcon	E	V	Species or species' habitat likely to occur within 10km (DAWE 2021a)	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The species is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. It also occurs near wetlands where surface water attracts prey.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. However, it should be noted that the proposal area does not occur within the range for the threatened species. It is therefore highly unlikely to be present.	Ecosystem
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M,MA	11 records within 10km (DPIE 2021a)	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Low – habitat preferences are not ideal in the proposal area. The proposal area lacks suitable inundation areas.	N/A
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	8 records within 10km (DPIE 2021a)	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. The species forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Species or species' habitat likely to occur within 10km (DAWE 2021a)	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. The species inhabits Boree/ Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. However, it should be noted that the proposal area occurs towards its far eastern distribution, and does not contain suitable habitat (ie. Box Gum Woodland and Myall Woodland. The species therefore has a	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						low likelihood to occur in the proposal area.	
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	-	M	15 records within 10km (DPIE 2021a)	The White-bellied Sea-eagle is widespread along the New South Wales coast, and along all major inland rivers and waterways. The species habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. It occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. The terrestrial habitats the species has been recorded in, include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	Dual credit species in the TBDC. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present. Breeding habitat (which constitutes the 'species credit' component) is the presence of nests. The field survey confirmed that the proposal area does not contain nests for the species.	Species/ecosystem
<i>Hieraetus morphnoides</i>	Little Eagle	V	-	21 records within 10km (DPIE 2021a)	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. The species occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. It nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Dual credit species in the TBDC. The species is regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present. Breeding habitat (which constitutes the 'species credit' component) is the presence of nests. The field survey confirmed that the proposal area does not contain nests for the species.	Species/ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Species or species' habitat known to occur within 10km (DAWE 2021a)	White-throated Needletails often occur in large numbers over eastern and northern Australia. White-throated Needletails are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees, and radio-tracking has since confirmed that this is a regular activity. White-throated Needletails are non-breeding migrants in Australia. Breeding takes place in northern Asia.	Low – may fly over the site on occasion but highly unlikely to rely on the habitat features of the site for migration and foraging.	-
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	2 records within 10km (DPIE 2021a)	In NSW, records of the Black Bittern are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. The species inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Lathamus discolor</i>	Swift parrot	E	E	40 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland the species occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Their favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Forest Red Gum <i>E. tereticornis</i> , Mugga Ironbark <i>E. sideroxydon</i> , and White Box <i>E. albens</i> .	Dual credit species in the TBDC. The species is regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present. The 'species credit' component is triggered if the proposal area occurs in an area mapped as 'important Swift Parrot habitat. The proposal areas does not occur within this mapped area of important habitat and thus the species credit component does not apply.	Species/ecosystem (SAIL breeding/foraging)

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	4 records within 10km (DPIE 2021a)	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. The species is found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, it has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland.	<p>Dual credit species in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.</p> <p>Breeding habitat is defined in the TBDC as '<i>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</i>'.</p> <p>The proposal area does not contain any significantly large trees that would offer suitable habitat for the species, nor do any stick nests occur. Furthermore, the species was not detected during the field campaign.</p>	Species/ecosystem
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	-	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form (subspecies <i>cucullata</i>) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies <i>picata</i> . The species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. It also requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	<p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.</p>	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater	V	-	1 record within 10km (DPIE 2021a)	In NSW the Black-chinned Honeyeater is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. The species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). It also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Species or species' habitat known to occur within 10km (DAWE 2021a)	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. It is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Low – habitat preferences not in proposal area. While remnant and regenerating Eucalypt woodlands are present, they consist of highly disturbed roadside patches. No rainforests, coastal scrub or damp gullies occur within the proposal area.	N/A
<i>Motacilla flava</i>	Yellow Wagtail	-	M, MA	Species or species' habitat likely to occur within 10km (DAWE 2021a)	The Yellow Wagtail breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Moderate – Disturbed areas containing grass occur within the proposal area, and waterbodies occur nearby however, no records of this species occur nearby with the nearest record being over 23km from the proposal area.	N/A
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Species or species' habitat known to occur within 10km (DAWE 2021a)	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin Flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant. The Satin Flycatcher is found in tall forests, preferring	Low – habitat preferences (such as gullies, wetter habitat types, tall forest and rainforest) are not present in proposal area.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
					wetter habitats such as heavily forested gullies, but not rainforests.		
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. The species typically lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Ninox connivens</i>	Barking Owl	V	-	-	The Barking Owl is found throughout continental Australia except for the central arid regions. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Extensive wildfires in 2019-20 reduced habitat quality further, burnt many old, hollow-bearing trees needed as refuge by prey species and reduced the viability of some regional owl populations. The species inhabit 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. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. The species typically roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species.	<p>Dual credit species listed in the TBDC.</p> <p>The species is regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.</p> <p>The 'species credit' component is triggered if the proposal area contains known nest tree(s)</p> <p>Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.</p> <p>The proposal area did not contain a living or dead tree with a hollow greater than 20 cm diameter and greater than 4m above the ground. Breeding habitat is therefore unlikely to be present.</p>	Ecosystem/ species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Ninox strenua</i>	Powerful Owl	V	-	10 records within 10km (DPIE 2021a)	"The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	<p>Dual credit species listed in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.</p> <p>The 'species credit' component is triggered if the proposal area contains known nest tree(s)</p> <p>Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.</p> <p>The proposal area did not contain a living or dead tree with a hollow greater than 20 cm diameter and greater than 4m above the ground. Breeding habitat is therefore unlikely to be present.</p>	Ecosystem/species
<i>Numenius madagascariensis</i>	Eastern Curlew	-	CE, MA, M	Species or species' habitat may occur within 10km (DAWE 2021a)	The Eastern Curlew is widespread in coastal regions in the north-east and south of Australia, including Tasmania, and scattered in other coastal areas. It is rarely seen inland. It breeds in Russia and north-eastern China. On passage, they are commonly seen in Japan, Korea and Borneo. Small numbers visit New Zealand. The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.	Low – habitat preferences (such as estuaries, mudflats, wetter habitat types, etc.) are not present in proposal area.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Pandion cristatus</i>	Eastern Osprey	V	M, MA	-	Found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	<p>Dual credit species in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.</p> <p>Breeding habitat is defined in the TBDC as nests.</p> <p>The proposal area does not contain any stick nests occur. Furthermore, the species was not detected during the field campaign.</p>	Species/ecosystem
<i>Petroica boodang</i>	Scarlet Robin	V	-	4 records within 10km (DPIE 2021a)	In NSW, the Scarlet Robin from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. The species habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Petroica phoenicea</i>	Flame Robin	V	-	4 records within 10km (DPIE 2021a)	In NSW, the Flame Robin breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. The species breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, it prefers clearings or areas with open understoreys.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Species or species' habitat known to occur within 10km (DAWE 2021a)	The Rufous Fantail is found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas.	Low – habitat preferences not in proposal area. No rainforests, dense wet forests, swamp woodlands or mangroves occur within the proposal area. This species sometimes occurs in more urban areas during migration so may fly through the site on occasion however, no records of this species occur nearby.	N/A
<i>Rostratula australis</i>	Australian Painted Snipe	E	E, M, MA	1 record within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	In NSW many records of the Australian Painted Snipe are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. The species prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	3 records within 10km (DPIE 2021a)	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Cental and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River. The species is found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. It also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities, and often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Stictonetta naevosa</i>	Freckled Duck	V	-	3 records within 10km (DPIE 2021a)	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
					rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times. The species prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	species is presumed to be present.	
<i>Tringa glareola</i>	Wood Sandpiper	-	M, MA	2 records within 10km, last recorded 1988 (DPIE 2021a)	Breeds in Northern Hemisphere. In Australia the Wood Sandpiper shuns coastal mudflats, instead occurring in shallow, freshwater wetlands, usually where there is grass or aquatic plants protruding above the water, and often with trees and much fallen timber. The species occurs in largest numbers in NW Australia, with all sites of national importance within WA. In NSW there are records east of the Divide north from Nowra, and inland from the upper and lower Western regions. Uses well-vegetated, shallow, freshwater wetlands and are typically associated with wetlands supporting emergent aquatic plants or grass and taller fringing vegetation such as dense reeds/rushes, shrubs or trees. Also frequent flooded grasslands and irrigated crops. Rarely in brackish wetlands or saltmarsh. Known from artificial wetlands.	Low –Dense reeds and rushes are absent for the proposal area. The species has not been recorded in the area for the past 30 years.	N/A
<i>Tringa nebularia</i>	Common Greenshank	-	M,MA	1 record within 10km (DPIE 2021a)	The Common Greenshank breeds in the Palaearctic regions and is widespread in Africa, Coastal Asia, the Indian subcontinent, the Philippines and southern New Guinea. They are common throughout Australia in the summer. Common Greenshanks are found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.	Low – habitat preferences not in proposal area.	N/A
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	5 records within 10km (DPIE 2021a)	The Masked Owl occurs from the coast where it is most abundant to the western plains. Overall records for this species fall within about 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. This species lives in dry eucalypt forests and woodlands from sea level to 1100 m an 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.	Dual credit species listed in the TBDC. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present. The 'species credit' component is triggered if the proposal area	Species/ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						<p>contains known nest tree(s)</p> <p>Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.</p> <p>The proposal area did not contain a living or dead tree with a hollow greater than 20 cm diameter and greater than 4m above the ground. Breeding habitat is therefore unlikely to be present.</p>	
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	1 record within 10km (DPIE 2021a)	The Sooty Owl occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. This species occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Sooty Owls roost by day in the hollow of a tall forest tree or in heavy vegetation and nest in very large tree hollows. This species hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (<i>Pseudocheirus peregrinus</i>) or Sugar Glider (<i>Petaurus breviceps</i>).	<p>Dual credit species listed in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.</p> <p>The 'species credit' component is triggered if the proposal area contains known nest tree(s)</p> <p>Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.</p> <p>The 'species credit' component may also be triggered if the site contains cliffs and overhangs.</p>	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						The proposal area did not contain a living or dead tree with a hollow greater than 20 cm diameter and greater than 4m above the ground. Nor does the site contain cliffs and overhangs. Breeding habitat is therefore unlikely to be present.	
Mammals							
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	V	-		The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. The species is found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to 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. It feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes and is an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	Low – The field survey did not detect the Eastern Pygmy Possum. The proposal area also does not occur within a location that fits the distribution of the species as described in the Scientific Determination for the species - 'In New South Wales the species is found in coastal areas and at higher elevation in the south, but north of Newcastle at higher elevation only'. This is supported by the closest record for the Eastern Pygmy Possum, occurring 12.6 km to the west of the proposal area in the Blue Mountains area.	Species
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	1 record within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. The species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40	Low – the species was not detected during Anabat analysis, and furthermore, the site does not occur within 2km of clifflines.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
					females) from November through to January in roof domes in sandstone caves and overhangs. It is found in well-timbered areas containing gullies.		
<i>Dasyurus maculatus</i>	Spotted-tail Quoll	V	E	4 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common. The species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares. Are known to traverse their home ranges along densely vegetated creeklines.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Low likelihood to utilise the proposal area on a regular basis. This is supported by the small number of records which occur in the locality, and the lack of connectivity to nearby bushland.	Ecosystem
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	13 records within 10km (DPIE 2021a)	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. The species prefer moist habitats, with trees taller than 20 m.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Moderate – not recorded during anabat analysis however may forage in the proposal area however, no breeding habitat.	Ecosystem
<i>Micronomus norfolkensis</i>	Eastern Freetail-bat	V	-	43 records within 10km (DPIE 2021a)	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. The species typically inhabit dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Moderate – not recorded during anabat analysis however may forage in the proposal area however, no breeding habitat.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	7 records within 10km (DPIE 2021a)	The Little Bentwing-bat occurs along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. It prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. The species roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	<p>Dual credit species listed in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.</p> <p>The 'species credit' component is triggered if the proposal area contains breeding habitat (defined in TBDC as - <i>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</i>".</p> <p>The species was recorded during the anabat analysis – and discussed in section 4.2.6.</p>	Species/ecosystem (SAIL breeding)
<i>Miniopterus orianae oceanensis</i>	Large Bentwinged Bat	V	-	63 records within 10km (DPIE 2021a)	Large Bentwing-bats occur along the east and north-west coasts of Australia. The species use caves as the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	<p>Dual credit species listed in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, foraging habitat for the species is presumed to be present.</p> <p>The 'species credit' component is triggered if</p>	Species/ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						<p>the proposal area contains breeding habitat (defined in TBDC as - <i>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</i>).</p> <p>The species was recorded during the anabat analysis – and discussed in section 4.2.6.</p>	
<i>Myotis macropus</i>	Southern Myotis	V	-	48 records within 10km (DPIE 2021a)	The Southern Myotis is mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water.	Species recorded during field survey on anabat device. The species is discussed in section 4.2.6.	Species
<i>Petauroides volans</i>	Greater Glider	-	V	Species or species' habitat likely to occur within 10km (DAWE 2021a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Low – Not recorded during field survey and no suitable habitat present.	-
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	1 record within 10km (DPIE 2021a)	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. The species occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Vegetation preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	2 records within 10km (DPIE 2021a)	The Squirrel Glider is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. The species inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	<p>Low - Not detected during spotlighting, nor has the species been recorded within the South Creek corridor during surveys for the Growth Centres, including the Airport which occurs greater habitat to that of the proposal area. The proposal area is a highly disturbed roadside areas subject to noise and light pollution.</p> <p>The species relies on large old trees with hollows for breeding and nesting. Such trees were relatively absent within the proposal area.</p>	Species
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Species or species' habitat may occur within 10km (DAWE 2021a)	In NSW the Brush-tailed Rock-wallaby occurs from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. The species occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. It typically shelters or basks during the day in rock crevices, caves and overhangs and are most active at night when foraging.	<p>None – no suitable habitat present. According to the TBDC, the species utilised '<i>Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliffines</i>'. The proposal area does not occur within 1 km of such features.</p>	Species
<i>Phascolarctos cinereus</i>	Koala	V	V	5 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range. The species inhabit eucalypt woodlands and forests, and feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	<p>Dual credit species listed in the TBDC.</p> <p>Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.</p> <p>Low likelihood to utilise the proposal area on a regular basis. This is</p>	Species/ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						supported by the SAT and spotlighting survey which did not detect any usage of the proposal area by Koalas. Given the small number of records which occur in the locality, the presence of predominately younger trees, and the lack of connectivity to nearby bushland, it is unlikely that this species occurs within the proposal area. Furthermore, if Koalas were in the area, it would be highly likely that there would be numerous records from passing motorists and residents.	
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	Species or species' habitat known to occur within 10km (DAWE 2021a)	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. The species is known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes	Low – habitat preferences not in proposal area. No records within the proposal area nor in the wider locality.	N/A
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	404 records within 10km (DPIE 2021a); Species roosting habitat known to occur within 10km (DAWE 2021a)	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. The species occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Dual credit species listed in the TBDC. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. The 'species credit' component is associated with the presence of camp sites. No camp sites were recorded in the proposal area, and thus the species is regarded as an ecosystem credit	Species/ ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						species for this assessment. The species was recorded flying over the proposal area however, no breeding habitat in proposal area.	
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	4 records within 10km (DPIE 2021a)	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. It forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	The species was recorded within the proposal area during anabat analysis. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	16 records within 10km (DPIE 2021a)	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. The species utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	The species was recorded within the proposal area during anabat analysis. Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Flora							
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	Species or species' habitat known to occur within 10km (DAWE 2021a)	Endemic to central eastern NSW, known a limited number of locations, often comprising populations of few plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey. The Team has extensive experience with this particular species.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Acacia pubescens</i>	Downy Wattle	V	V	56 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravelly, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers from August to October.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Allocasuarina glareicola</i>	Allocasuarina glareicola	E	E	2 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	"Primarily found in Richmond district; although outlier populations exist in Voyager Point, Liverpool. Found in open castlereagh woodland on lateritic soil. The species is associated with the following species: Parramatta Red Gum, Red Ironbark, Narrow-leaved Apple, Hard-leaved Scribbly Gum and Melaleuca decora. Common associated understorey species include Prickly-leaved Paperbark, Finger Hakea, Needlebush, Dillwynia tenuifolia, Micromyrtus minutiflora, Swamp Wattle, Acacia brownei, Themeda australis and Xanthorrhoea minor.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Vegetation types within the proposal area are not of Castlereagh woodland. Unlikely to remain undetected during field survey.	Species
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V		Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils. There are 'old records' for the species within the Sydney Region near Hunters Hill in 1876. Flowers between September and November.	Low – not recorded during targeted survey in correct survey period. Furthermore the species has not been recorded in the region historically, nor has it been recorded in field surveys from the Growth Centre Projects which were relatively extensive.	Species
<i>Callistemon lineariifolius</i>	Netted Bottle Brush	V	-	1 record within 10km (DPIE 2021a)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers from spring to summer	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	1 record within 10km (DPIE 2021a)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers from spring to summer	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						remain undetected during field survey.	
<i>Deyeuxia appressa</i>	Deyeuxia appressa	E	E	None since 1942	Known only from two pre-1942 records in Sydney, at Saltpan Creek and Killara. May be extinct in the wild. Thought to occur in moist conditions.	Low – Whilst the survey was not completed during December, the likelihood for the presence of this species is very low. The species has not been recorded since 1942 in Sydney, and the areas of previous occupancy are not near the proposal area. Furthermore, the site does not contain 'moist' conditions.	Species
<i>Dillwynia tenuifolia</i>	Dillwynia tenuifolia	V	-	1129 records within 10km (DPIE 2021a)	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Dillwynia tenuifolia</i>	Dillwynia tenuifolia, Kemps Creek	EP	-	92 records within 10km (DPIE 2021a)	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	None – the proposal area does not occur in Kemps Creek.	Species
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V		Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). Two major subpopulations in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E	Species or species' habitat may occur within 10km (DAWE 2021a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers from February to March.	Low – The habitat present within the proposal area is not located within an area of a known population; does not contain sandstone habitat types.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper – Leaved Grevillea	V	-	3038 records within 10km (DPIE 2021a)	Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forests.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flowered Grevillea	V	V	18 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Gyrostemon thesioides</i>		E	-		Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. The most recent sighting was of a single male plant near the Colo River within Wollemi National Park. Despite searches, the species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively. Grows on hillsides and riverbanks and may be restricted to fine sandy soils.	Low – not recorded during targeted survey. Unlikely to remain undetected during field survey.	Species
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Square Raspwort	V	V	Species or species' habitat may occur within 10km (DAWE 2021a)	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Requires protected and shaded damp situations in riparian habitats.	Low – not recorded during targeted survey. Unlikely to remain undetected during field survey.	Species
<i>Hibbertia</i> sp. <i>Bankstown</i>		CE	CE		Listed under EPBC Act as <i>Hibbertia puberula</i> subsp. <i>glabrescens</i> . Known only from Bankstown airport. Habitat is very heavily modified, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content and is associated with Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion.	Low – not recorded during targeted survey, and the proposal area does not occur in Bankstown.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Hibbertia puberula</i>	Hibbertia puberula	E	-	3 records within 10km (DPIE 2021a)	Distribution extending from Wollemi National Park south to Morton National Park and the south coast near Nowra. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. Flowers from October to January	Low – The habitat types are not suitable for this species given the species prefers sandy soils, whilst the proposal area contains clay and loam soils.	Species
<i>Isotoma fluviatilis subsp. fluviatilis</i>		-	Extinct	8 records within 10km (DPIE 2021a)	Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as <i>Cyndon dactylon</i> .	Low – not recorded during targeted survey. Unlikely to remain undetected during field survey.	-
<i>Macadamia integrifolia</i>	Macadamia Nut		V	4 records within 10km (DPIE 2021a)	The Macadamia Nut is found in remnant rainforest in northern NSW and south-east Queensland, preferring partially open areas such as rainforest edges. While specimens have been collected from the North Coast of NSW, this species is not known to occur naturally in NSW.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Marsdenia viridiflora subsp. viridiflora</i>	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP	-	1258 records within 10km (DPIE 2021a)	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Maundia triglochinosides</i>	-	V	-		Restricted to coastal NSW current southern limit at Wyong. Grows on heavy clay, low nutrient soil in swamps, lagoons, dams, channels, creeks or shallow freshwater 30-60 cm depth.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						not flowering. Unlikely to remain undetected during field survey. Field team is experience with this species given a experience with long-standing Maundia triglochinos monitoring program for Pacific Highway Upgrade (Oxley to Kempsey).	
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Species or species' habitat may occur within 10km (DAWE 2021a)	Occurs from Nowra to St Albans and west to the Blue Mountains, with most records in Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Micromyrtus minutiflora</i>		E	V	30 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	Occurs in Richmond and Penrith areas in western Sydney. Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Species or species' habitat may occur within 10km (DAWE 2021a)	Tall Knotweed has been recorded in south-eastern NSW from Ulladulla to the Victorian border. In northern NSW it is known from Raymond Terrace and the Grafton area. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Persoonia bargoensis</i>	Bargo Geebung	E	V		Restricted to the western edge of the Woronora Plateau and the northern edge of the Southern Highlands, bounded by Picton, Douglas Park, Yanderra and the Cataract River. Occurs in woodland or dry sclerophyll forest on sandstone and clayey laterite on heavier, well drained, loamy, gravelly soils of Hawkesbury Sandstone and Wianamatta Shale. Tends to occur in disturbed areas e.g. roadsides and trail margins. pterostylis	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey. The proposal area is outside of the	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
						typical range for this species.	
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	Species or species' habitat likely to occur within 10km (DAWE 2021a)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600 m above sea level.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Persoonia nutans</i>	Nodding Geebung	E	E	32 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	E	-	1 record within 10km, last recorded 1966 (DPIE 2021a)	Only known extant populations in NSW are at Lake Cowal and Oolambeyan NP, but the species is obscure and may be overlooked elsewhere. Grows in shallow swamps and waterways, often among grasses and sedges. Previous records in Albury-Urana were from table drains beside roads, whereas the only record in the ACT was from a subalpine grassy plain.	Low – habitat is less than ideal throughout much of the proposal area. The only area of potential habitat is located within PCT 835 Low towards the north of the proposal area. This area contained some native sedges and rushes, and would offer a wetter environment which the species is associated with however the ground cover is highly dominated by introduced grasses which is quite reasonable to conclude would prevent <i>Pilularia novae-hollandiae</i> from occurring.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	2 records within 10km (DPIE 2021a); Species or species' habitat may occur within 10km (DAWE 2021a)	Confined to area between north Sydney in the south and Maroota in the north-west. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Low – habitat types is not suitable for this species given the proposal area is located away from ridgetops and upper slopes.	Species
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	452 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	Disjunct populations within the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the Cumberland Plain sites it is associated with Grey Box communities. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Pomaderris brunnea</i>	Brown Pomaderris	V	V	Species or species' habitat likely to occur within 10km (DAWE 2021a)	Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Pterostylis gibbosa</i>		E	E	Species or species' habitat may occur within 10km (DAWE 2021a)	Known from a small number of populations in the Illawarra, Shoalhaven and Hunter regions. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum, Woollybutt and Melaleuca decora. Near Nowra, the species grows in an open forest of Spotted Gum, Forest Red Gum and Grey Ironbark. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark, Forest Red Gum and Black Cypress Pine.	Low – not recorded during targeted survey during correct survey month.	Species
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	1 record within 10km, last recorded 1900 (DPIE 2021a); Species or species' habitat likely to occur within	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Low – habitat types within the proposal area are not suitable for this species given the absence of sandstone rock shelves.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
				10km (DAWE 2021a)			
<i>Pultenaea parviflora</i>		E	V	722 records within 10km (DPIE 2021a); Species or species' habitat known to occur within 10km (DAWE 2021a)	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E	-		In NSW there are three disjunct populations in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. NSW populations typically among woodland vegetation but also found on road batters and coastal cliffs. In Windellama it is largely confined to loamy soils in dry gullies.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species
<i>Rhizanthella slateri</i>	Eastern Australian Undergrown Orchid	V	E	Species or species' habitat may occur within 10km (DAWE 2021a)	Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available. Flowers September and November.	Low – not recorded during targeted survey completed during correct survey month.	Species
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	-	Species or species' habitat may occur within 10km (DAWE 2021a)	Occurs in coastal districts north from Batemans Bay in New South Wales, to areas inland of Bundaberg in Queensland. Populations of <i>R. rubescens</i> typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000 -1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Low – not recorded during targeted survey.	Species
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	1 record within 10km (DPIE 2021a); Species or species' habitat may occur within 10km (DAWE 2021a)	Occurs in narrow coastal strip from Upper Lansdowne to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Low – not recorded during targeted survey. Relatively conspicuous species even when it is not flowering. Unlikely to remain undetected during field survey.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Source	Habitat	Likelihood of occurrence	Credit type
<i>Thesium australe</i>	Austral Toadlax	V	V	Species or species' habitat may occur within 10km (DAWE 2021a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Low – not detected during survey	Species

Likelihood of occurrence – Threatened ecological communities

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of Occurrence within proposal area
<p>Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion</p>	<p>The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is located in the Sydney Basin Bioregion. It occurs primarily in the Castlereagh area in the north-west of the Cumberland Plain (also referred to as the Cumberland sub-region), with other known occurrences near Holsworthy (some patches at Holsworthy are just outside the Cumberland sub-region), Kemps Creek and Longneck Lagoon. The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is typically a low woodland, with canopy species reaching an average 15 m in height, but with some trees growing to around 20 m. The ecological community's understorey has a prominent and diverse mid-layer of sclerophyll shrubs. It typically has a patchy ground cover of sedges and grasses. However, in areas of poorly drained soil there may be less species diversity in the mid layer and the ground layer may contain a high diversity of sedges and grasses. The isolation of the alluvial deposits in the Hawkesbury-Nepean river valley and differences in the soil characteristics have led to the development of differences in species composition and abundance across the range of the ecological community. For example, this is expressed in differing abundance of <i>Melaleuca</i> and <i>Banksia</i> species in the mid stratum. In addition, the Agnes Banks vegetation occurs on aeolian sand and can contain a number of species reminiscent of communities closer to the coast, such as <i>Dillwynia glaberrima</i>, <i>Ricinocarpos pinifolius</i> (wedding bush) and <i>Banksia aemula</i> (wallum).</p>	<p>Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion - Vulnerable / Agnes Banks Woodland in the Sydney Basin Bioregion - Critically Endangered.</p>	<p>Endangered</p>	<p>Does not occur</p>

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of Occurrence within proposal area
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland	<p>Known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers. Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which <i>Casuarina glauca</i> (swamp oak) is the dominant species northwards from Bermagui. Other trees including <i>Acmena smithii</i> (lilly pilly), <i>Glochidion</i> spp. (cheese trees) and <i>Melaleuca</i> spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and <i>Melaleuca ericifolia</i> is the only abundant tree in this community south of Bermagui. The understorey is characterised by frequent occurrences of vines, <i>Parsonsia straminea</i>, <i>Geitonoplesium cymosum</i> and <i>Stephania japonica</i> var. <i>discolor</i>, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such <i>Centella asiatica</i>, <i>Commelina cyanea</i>, <i>Persicaria decipiens</i> and <i>Viola banksii</i>; graminoids such as <i>Carex appressa</i>, <i>Gahnia clarkei</i>, <i>Lomandra longifolia</i>, <i>Oplismenus imbecillis</i>; and the fern <i>Hypolepis muelleri</i>. On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, <i>Alexfloydia repens</i>, as well as <i>Baumea juncea</i>, <i>Juncus kraussii</i>, <i>Phragmites australis</i>, <i>Selliera radicans</i> and other saltmarsh species.</p>	Endangered	Endangered	Low likelihood to occur

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of Occurrence within proposal area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Occurs in western Sydney, and the extent of intact remnants is now reduced to 1011 hectares, with the most extensive stands occurring in the Castlereagh and Holsworthy areas. Smaller remnants occur in the Kemps Creek area and in the eastern section of the Cumberland Plain. Good examples can be seen at the Castlereagh and Windsor Downs Nature Reserves. Has a very restricted natural distribution and mainly occurs on clay soils derived from the deposits of ancient river systems (alluvium), or on shale soils of the Wianamatta Shales. Can intergrade into Shale-Gravel Transition Forest (where the alluvium is shallow), Castlereagh Swamp Woodland (in moist depressions) and Castlereagh Scribbly Gum Woodland (on sandier soils). Most species in the community are able to regenerate from lignotubers and buds beneath the bark as well as seeds stored in the soil. Ranges from open forest to low woodland, with a canopy dominated by Broad-leaved Ironbark (<i>Eucalyptus fibrosa</i>) and Paperbark (<i>Melaleuca decora</i>). The canopy may also include other eucalypts such as Woollybutt (<i>E. longifolia</i>). The dense shrubby understorey consists of Prickly-leaved Paperbark (<i>Melaleuca nodosa</i>) and Peach Heath (<i>Lissanthe strigosa</i>), with a range of 'pea' flower shrubs, such as Dillwynia tenuifolia, Hairy Bush-pea (<i>Pultenaea villosa</i>) and Gorse Bitter Pea (<i>Daviesia ulicifolia</i>) (can be locally abundant). The sparse ground layer contains a range of grasses and herbs.	Endangered	Critically Endangered	Does not occur
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. Before European settlement, was extensive across the Cumberland Plain, western Sydney. Today, only 9 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain. Good examples can be seen at Scheyville National Park and Mulgoa Nature Reserve. Typically occurs on heavy clay soils derived from Wianamatta Shale. Well adapted to drought and fire, and the understorey plants often rely on underground tubers or profuse annual seed production to survive adverse conditions. Cumberland Plain Woodland is habitat for threatened species such as the Cumberland land snail (<i>Meridolum corneovirens</i>). The dominant canopy trees of Cumberland Plain Woodland are Grey Box (<i>Eucalyptus moluccana</i>) and Forest Red Gum (<i>E. tereticornis</i>), with Narrow-leaved Ironbark (<i>E. crebra</i>), Spotted Gum (<i>Corymbia maculata</i>) and Thin-leaved Stringybark (<i>E. eugenioides</i>) occurring less frequently. The shrub layer is dominated by Blackthorn (<i>Bursaria spinosa</i>), and it is common to find abundant grasses such as Kangaroo Grass (<i>Themeda australis</i>) and Weeping Meadow Grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>).	Endangered	Critically Endangered	Present

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of Occurrence within proposal area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	<p>Known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability. Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. River-Flat Eucalypt Forest on Coastal Floodplains provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting. These include cormorants and egrets, the Osprey (<i>Pandion haliaetus</i>), Whistling Kite (<i>Haliastur sphenurus</i>), White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>), as well as the Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>), Yellow-bellied Glider (<i>Petaurus australis</i>), Squirrel Glider (<i>Petaurus norfolcensis</i>), Sugar Glider (<i>Petaurus breviceps</i>) and Grey-headed Flying Fox (<i>Pteropus poliocephalus</i>). As the name suggests, this EEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (forest red gum), <i>E. amplifolia</i> (cabbage gum), <i>Angophora floribunda</i> (rough-barked apple) and <i>A. subvelutina</i> (broad-leaved apple). <i>Eucalyptus baueriana</i> (blue box), <i>E. botryoides</i> (bangalay) and <i>E. elata</i> (river peppermint) may be common south from Sydney, <i>E. ovata</i> (swamp gum) occurs on the far south coast, <i>E. saligna</i> (Sydney blue gum) and <i>E. grandis</i> (flooded gum) may occur north of Sydney, while <i>E. benthamii</i> is restricted to the Hawkesbury floodplain. A layer of small trees may be present, including <i>Melaleuca decora</i>, <i>M. styphelioides</i> (prickly-leaved teatree), <i>Backhousia myrtifolia</i> (grey myrtle), <i>Melia azaderach</i> (white cedar), <i>Casuarina cunninghamiana</i> (river oak) and <i>C. glauca</i> (swamp oak). Scattered shrubs include <i>Bursaria spinosa</i>, <i>Solanum prinophyllum</i>, <i>Rubus parvifolius</i>, <i>Breynia oblongifolia</i>, <i>Ozothamnus diosmifolius</i>, <i>Hymenanthera dentata</i>, <i>Acacia floribunda</i> and <i>Phyllanthus gunnii</i>. The groundcover is composed of abundant forbs, scramblers and grasses including <i>Microlaena stipoides</i>, <i>Dichondra repens</i>, <i>Glycine clandestina</i>, <i>Oplismenus aemulus</i>, <i>Desmodium gunnii</i>, <i>Pratia purpurascens</i>, <i>Entolasia marginata</i>, <i>Oxalis perennans</i> and <i>Veronica plebeian</i>. The composition and structure of the understory is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs.</p>	Endangered	Critically Endangered	Present

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of Occurrence within proposal area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	<p>Before European settlement, this community was extensive around the edges of the Cumberland lowlands throughout western Sydney, most particularly in the southern half. Today, only 9,950 ha remains intact (22.6% of its original extent) and the bulk of this occurs in the Hawkesbury, Baulkham Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly local government areas. Good examples can be seen at Gulguer Nature Reserve, in the Wilton area and in the Sackville - Maroota area. Well adapted to fire, being often close to sandstone areas. Some species in areas with greater shale influence regenerate from profuse annual seeding and underground tubers. High-sandstone-influence sites have poor rocky soils, and many shrubs which rely on nitrogen-fixing root nodules and soil/root fungi to obtain nutrients. High-shale-influence sites often have a diverse and moderately dense groundcover stratum, with grasses a prominent and diverse component. Shrubs are usually less abundant and less diverse in shale sites. Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include Forest Red Gum (<i>Eucalyptus tereticornis</i>), Grey Gum (<i>E. punctata</i>), stringybarks (<i>E. globoidea</i>, <i>E. eugenioides</i>) and ironbarks (<i>E. fibrosa</i> and <i>E. crebra</i>). Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland.</p>	Critically Endangered	Critically Endangered	Does not occur
Western Sydney Dry Rainforest and Moist Woodland on Shale	<p>Very restricted and occurs most commonly in the far southern section of the Cumberland Plain, in the Razorback Range near Picton. Outlying occurrences have been recorded at Grose Vale and Cattai. There are 338 hectares remaining intact, the majority of these occurring in the Wollondilly local government area, but occurring to a lesser extent in the Baulkham Hills, Camden, Hawkesbury, Parramatta and Ryde local government areas. A small remnant can be seen in Fairfield City Farm. Restricted to hilly country where it occurs on the sheltered lower slopes and in gullies. Generally found at higher elevation, in areas receiving higher rainfall than much of the Cumberland Plain Woodland. Occurs on clay soils derived from Wianamatta shale. Rainforest plants within this vegetation are fire sensitive and dependent on the sheltered aspect and density of vegetation for protection. Vine thickets in Western Sydney Dry Rainforest provide good habitat for birds and mammals. Several species of plants (including <i>Spartothamnella juncea</i> and rare and threatened such as <i>Marsdenia viridiflora</i>) have their southern distribution limit within areas of Western Sydney Dry Rainforest. A dry vine scrub community of the Cumberland Plain, western Sydney. Canopy trees include Prickly Paperbark (<i>Melaleuca styphelioides</i>), Hickory Wattle (<i>Acacia implexa</i>) and Native Quince (<i>Alectryon subcinereus</i>). There are many rainforest species in the shrub layer, such as Mock Olive (<i>Notolaea longifolia</i>), Hairy Clerodendrum (<i>Clerodendrum tomentosum</i>) and Yellow Pittosporum (<i>Pittosporum revolutum</i>). The shrub layer combines with vines, such as Gum Vine (<i>Aphanopetalum resinosum</i>), Wonga Vine (<i>Pandorea pandorana</i>) and Slender Grape (<i>Cayratia clematidea</i>) to form dense thickets in sheltered locations. Contains many more species and other references should be consulted to identify these.</p>	Endangered	Critically Endangered	Does not occur

Annexure B

Species recorded

Recorded flora

Family	Scientific Name	Common Name	Threatened species ?		Cover								
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet	-	-				0.1	0.1		0.1		
Alismataceae	<i>Sagittaria platyphylla</i>	Sagittaria	-	-		0.5							
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort	-	-	0.1		0.1				0.1		0.1
Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	-	-					0.1	0.2			0.1
Araliaceae	<i>Hydrocotyle ranunculoides</i>	N/A	-	-		0.1							
Asparagaceae	<i>Asparagus aethiopicus</i>	Asparagus Fern	-	-				0.1		0.1			
Asparagaceae	<i>Asparagus asparagoides</i>	Bridal Creeper	-	-			0.1	0.5	0.5	0.1		5	
Asparagaceae	<i>Asparagus officinalis</i>	Asparagus	-	-		0.1	0.2	0.1					
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed	-	-								0.1	
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	-	-			0.1		0.1	0.1		0.1	
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	-	-		0.1	0.5	0.1	0.1	0.1	0.1		
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	-	-			0.1					0.1	0.1
Asteraceae	<i>Euchiton sphaericus</i>	Star Cudweed	-	-			0.1						
Asteraceae	<i>Hypochaeris radicata</i>	Catsear	-	-	0.2		0.5				0.1		0.1

Family	Scientific Name	Common Name	Threatened species ?		Cover								
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	-	-			0.1	0.1		0.1	0.1		0.1
Asteraceae	<i>Soliva sessilis</i>	Bindyi	-	-		0.1							
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	-	-			0.1						0.1
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	-	-			0.1	0.1					0.1
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak	-	-						1		15	
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort	-	-	0.1		0.1						
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew	-	-					0.1	1			
Commelinaceae	<i>Tradescantia fluminensis</i>	Wandering Jew	-	-		0.1							
Convolvulaceae	<i>Convolvulus erubescens</i>	Pink Bindweed	-	-							0.2		
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	-	-			0.5	0.1	5	5		0.1	
Cyperaceae	<i>Cyperus eragrostis</i>	Umbrella Sedge	-	-								1	
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	-	-			0.1						0.1
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	-	-	0.1								

Family	Scientific Name	Common Name	Threatened species ?		Cover									
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge	-	-		5								
Cyperaceae	<i>Schoenoplectus validus</i>	N/A	-	-		5								
Dilleniaceae	<i>Hibbertia sp.</i>	N/A	-	-	0.5									
Ericaceae	<i>Astroloma humifusum</i>	Native Cranberry	-	-							0.1			
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	-	-	0.5									
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	Small-leaf Glycine	-	-			0.1		0.1	0.1				0.1
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine	-	-	0.1		0.1	0.1		0.1	0.1			0.1
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover	-	-										0.1
Fabaceae (Faboideae)	<i>Vicia sativa</i>	Common vetch	-	-										0.1
Fabaceae (Mimosoideae)	<i>Acacia brownii</i>	Heath Wattle	-	-	5									
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Black Wattle	-	-							1			
Fabaceae (Mimosoideae)	<i>Acacia parramattensis</i>	Parramatta Wattle	-	-	1		0.5	1						
Fabaceae (Mimosoideae)	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle	-	-	0.1		1							

Family	Scientific Name	Common Name	Threatened species ?		Cover									
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	
Gentianaceae	<i>Centaurium tenuiflorum</i>	Branched Centaury, Slender centaury	-	-								0.1		
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium	-	-							0.1		1	
Goodeniaceae	<i>Goodenia sp.</i>	N/A	-	-				0.1						
Haloragaceae	<i>Myriophyllum aquaticum</i>	Parrots Feather	-	-		10								
Hydrocharitaceae	<i>Ottelia ovalifolia subsp. ovalifolia</i>	Swamp Lily	-	-		0.1								
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel	-	-		10	1							1
Lobeliaceae	<i>Lobelia purpurascens</i>	Whiteroot	-	-									0.1	
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	-	-							0.1		0.1	
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	-	-										0.1
Malvaceae	<i>Pavonia hastata</i>	N/A	-	-			0.5						0.1	
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	-	-			1	0.5	0.1	0.1			0.1	0.1
Malvaceae	<i>Sida trichopoda</i>	High Sida	-	-						0.5				0.1
Meliaceae	<i>Melia azedarach</i>	White Cedar	-	-						0.1				

Family	Scientific Name	Common Name	Threatened species ?		Cover									
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	
Myrsinaceae	<i>Lysimachia arvensis</i>	Scarlet Pimpernel	-	-										0.1
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	-	-										10
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum	-	-				5						
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark	-	-										2
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box	-	-				15	10					
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	-	-	15		30		20	35	1			10
Myrtaceae	<i>Melaleuca decora</i>	N/A	-	-	0.1									
Oleaceae	<i>Ligustrum lucidum</i>	Large-leaved Privet	-	-			5	1	1	0.1				0.1
Oleaceae	<i>Ligustrum sinense</i>	Small-leaved Privet	-	-			0.1	0.1	10	10			10	
Oleaceae	<i>Olea europaea subsp. cuspidata</i>	African Olive	-	-	0.1		15	20	10	0.1			5	0.1
Oxalidaceae	<i>Oxalis perennans</i>	N/A	-	-	0.1		0.1	0.1	0.1				0.1	0.1
Passifloraceae	<i>Passiflora morifolia</i>	N/A	-	-	0.1		5	5						
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax-lily	-	-					0.1			0.1		
Phyllanthaceae	<i>Phyllanthus gunnii</i>	N/A	-	-	0.1									
Phyllanthaceae	<i>Poranthera microphylla</i>	Small Poranthera	-	-										0.1

Family	Scientific Name	Common Name	Threatened species ?		Cover									
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	
Pittosporaceae	<i>Bursaria spinosa</i>	Native Blackthorn	-	-						10				
Pittosporaceae	<i>Bursaria spinosa subsp. spinosa</i>	Native Blackthorn	-	-			0.1			10	10			
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	-	-			0.1		0.1					0.5
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	-	-			0.1							
Poaceae	<i>Bothriochloa decipiens var. decipiens</i>	Pitted Bluegrass	-	-	0.1									
Poaceae	<i>Bothriochloa macra</i>	Red Grass	-	-				0.2						
Poaceae	<i>Briza subaristata</i>	Quiver grass	-	-	0.1									
Poaceae	<i>Bromus diandrus</i>	Great Brome	-	-										1
Poaceae	<i>Cenchrus clandestinus</i>	Kikuyu	-	-		10								
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	-	-				0.5			40			0.5
Poaceae	<i>Cynodon dactylon</i>	Common Couch	-	-	20		0.5	10				0.5		1
Poaceae	<i>Digitaria parviflora</i>	Small-flowered Finger Grass	-	-	0.1									
Poaceae	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass	-	-						0.1				

Family	Scientific Name	Common Name	Threatened species ?		Cover								
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	-	-						0.5		0.1	0.1
Poaceae	<i>Entolasia marginata</i>	Bordered Panic	-	-						0.1			
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	-	-	80		0.1	60	0.5		1		0.5
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	-	-	0.1		0.1						
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	-	-					80	80			
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	-	-				10				0.1	
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass	-	-						15			
Poaceae	<i>Oplismenus imbecillis</i>	Basket Grass	-	-								5	
Poaceae	<i>Paspalidium</i> sp.	N/A	-	-	0.1								
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	-	-	5	0.5	5	0.5	1	0.1	40	1	5
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	Tussock	-	-						0.1			
Poaceae	<i>Setaria palmifolia</i>	Palm Grass	-	-			0.1						
Poaceae	<i>Setaria parviflora</i>	N/A	-	-	5		1	0.5	1	0.1	0.1		
Poaceae	<i>Sporobolus africanus</i>	Parramatta Grass	-	-			0.1						

Family	Scientific Name	Common Name	Threatened species ?		Cover									
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass	-	-					0.1					
Poaceae	<i>Themeda triandra</i>	Kangaroo grass	-	-	0.1						5			
Polygonaceae	<i>Persicaria hydropiper</i>	Knotweed	-	-		0.1						5		
Polygonaceae	<i>Rumex crispus</i>	Curled Dock	-	-		10						2	0.1	
Proteaceae	<i>Grevillea robusta</i>	Silky Oak	-	-					1					
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard	-	-					0.1	5		5		
Rosaceae	<i>Rubus fruticosus sp. agg.</i>	Blackberry complex	-	-		10			0.1		1	5	0.1	
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff	-	-					0.1					
Rubiaceae	<i>Galium aparine</i>	Goosegrass	-	-		0.1						0.1		
Sapindaceae	<i>Cardiospermum grandiflorum</i>	Balloon Vine	-	-								0.1		
Sapindaceae	<i>Dodonaea viscosa</i>	Sticky Hop-bush	-	-	0.1									
Solanaceae	<i>Cestrum parqui</i>	Green Cestrum	-	-			0.1	0.1				5		
Solanaceae	<i>Solanum mauritianum</i>	Wild Tobacco Bush	-	-						0.1				
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	-	-				0.1						

Family	Scientific Name	Common Name	Threatened species ?		Cover									
			BC Act	EPBC Act	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade	-	-							0.1			
Solanaceae	<i>Solanum pseudocapsicum</i>	Madeira Winter Cherry	-	-				0.1		0.1			5	
Solanaceae	<i>Solanum sisymbriifolium</i>	N/A	-	-				0.1						
Ulmaceae	<i>Celtis occidentalis</i>	Hackberry	-	-			0.1							
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	-	-			0.1	0.1	0.1	0.1	2	0.1		

Recorded fauna

Taxa/Fauna group	Scientific Name	Common name	Status	
			BC Act	EPBC Act
Gastropoda	<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	P	E
Actinopterygii	<i>Anguilla</i> sp.	Shortfin Eel	P	-
Actinopterygii	<i>Gambusia holbrooki</i>	Mosquito Fish	-	-
Amphibia	<i>Crinia signifera</i>	Common Eastern Froglet	P	-
Amphibia	<i>Limnodynastes peronii</i>	Brown-striped Frog	P	-
Amphibia	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	P	-
Reptilia	<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle	P	-
Reptilia	<i>Intellagama lesueurii</i>	Eastern Water Dragon	P	-
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P	-
Aves	<i>Acanthiza pusilla</i>	Brown Thornbill	P	-
Aves	<i>Acridotheres tristis</i>	Common Myna	-	-
Aves	<i>Anthochaera carunculata</i>	Red Wattlebird	P	-
Aves	<i>Anthochaera chrysoptera</i>	Little Wattlebird	P	-
Aves	<i>Bubulcus ibis</i>	Cattle Egret	P	M
Aves	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	-
Aves	<i>Corvus coronoides</i>	Australian Raven	P	-
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	-
Aves	<i>Egretta novaehollandiae</i>	White-faced Heron	P	-
Aves	<i>Malurus cyaneus</i>	Superb Fairy-wren	P	-
Aves	<i>Manorina melanocephala</i>	Noisy Miner	P	-

Taxa/Fauna group	Scientific Name	Common name	Status	
			BC Act	EPBC Act
Aves	<i>Ninox novaeseelandiae</i>	Southern Boobook	P	-
Aves	<i>Psophodes olivaceus</i>	Eastern Whipbird	P	-
Aves	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	-	-
Aves	<i>Rhipidura leucophrys</i>	Willie Wagtail	P	-
Aves	<i>Strepera fuliginosa</i>	Black Currawong	P	-
Aves	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	P	-
Mammalia	<i>Felis catus</i>	Cat	-	-
Mammalia	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	-
Mammalia	Microchiroptera suborder	Unidentified Microbat		
Mammalia	<i>Mus musculus</i>	House Mouse	-	-
Mammalia	<i>Petaurus breviceps</i>	Sugar Glider	P	-
Mammalia	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	P,V	V
Mammalia	<i>Pteropus</i> sp.	Flying Fox	P	-
Mammalia	<i>Rattus rattus</i>	Black Rat	-	-
Mammalia	<i>Trichosurus vulpecula</i>	Common Brushtail		
Mammalian - microbats	<i>Austronomus australis</i>	White-striped freetail bat	P	-
Mammalian - microbats	<i>Chalinolobus gouldii</i>	Gould's wattled bat	P	-
Mammalian - microbats	<i>Chalinolobus morio</i>	Chocolate wattled bat	P	-
Mammalian - microbats	<i>Miniopterus australis</i>	Little bent wing bat	V	-
Mammalian - microbats	<i>Miniopterus orianae oceanensis</i>	Large bent wing bat	V	-
Mammalian - microbats	<i>Myotis macropus</i>	Southern Myotis	E	-

Taxa/Fauna group	Scientific Name	Common name	Status	
			BC Act	EPBC Act
Mammalian - microbats	Nyctophilus species	Long-eared bats	P	-
Mammalian - microbats	Ozimops planiceps	South eastern freetail bat	P	-
Mammalian - microbats	Ozimops ridei	Rides freetail bat	Not listed	-
Mammalian - microbats	Saccolaimus flaviventris	Yellow-bellied sheath tail bay	V	-
Mammalian - microbats	Scoteanax ruepellii	Greater broad nosed bat	V	-
Mammalian - microbats	Vespadelus darlingtoni	Large forest bat	P	-
Mammalian - microbats	Vespadelus vulturnus	Little forest bat	P	-

Annexure C

Hollow-bearing Tree Register

Tree no.	Location	Tree type	Hollow size	Hollow height
1	-33.78799432/ 150.7702809	<i>Eucalyptus Tereiticornis</i>	5-10 cm	15 m
2	-33.79889964/ 150.7683031	<i>Eucalyptus moluccana</i>	5-10 cm	12 m
3	-33.80170355/ 150.7680993	<i>Eucalyptus moluccana</i>	5-10 cm	10 m
4	-33.79967111/ 150.7682817	<i>Eucalyptus moluccana</i>	5-10 cm	15-20 m
5	-33.79356126/ 150.7694258	<i>Eucalyptus moluccana</i>	10-15 cm	10 m
6	-33.79762748/ 150.7679963	Unknown	0-5 cm	5-10 m
7	-33.79763918/ 150.7683732	<i>Eucalyptus spp.</i>	0-5 cm	10 m
8	-33.79253672/ 150.7695621	<i>Eucalyptus eugenioides</i>	15-20 cm	5-15 m
9	-33.7922071/ 150.769607	<i>Eucalyptus moluccana</i>	0-5 cm	20 m
10	-33.81031712/ 150.773994	Unknown	5-10 cm	5-10 m

Annexure D

EPBC Protected Matters Search results



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/05/21 16:18:05

[Summary](#)

[Details](#)

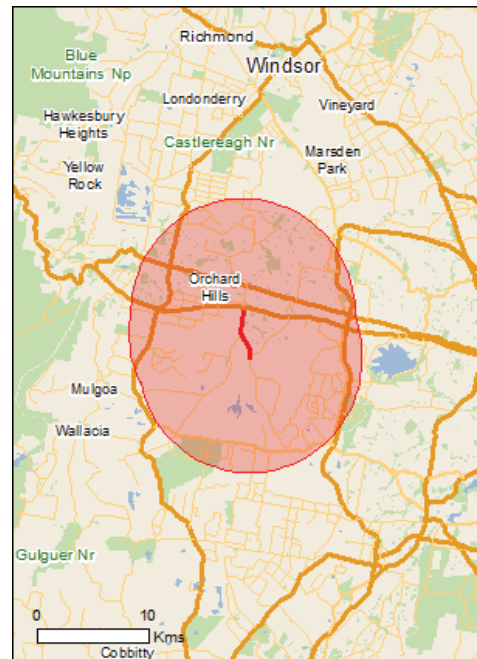
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

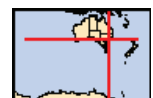
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Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	43
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	17
Commonwealth Heritage Places:	2
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	50
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [[Resource Information](#)]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community may occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community likely to occur within area

Listed Threatened Species [[Resource Information](#)]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Endangered	habitat may occur within area Species or species habitat known to occur within area
Fish		
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat known to occur within area
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat known to occur within area
Allocastrum glareicola [21932]	Endangered	Migration route known to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat may occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat may occur within area
Micromyrtus minutiflora [11485]	Vulnerable	Species or species habitat known to occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat likely to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat known to occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area
Pomaderris brunnea Rufous Pomaderris, Brown Pomaderris [16845]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat likely to occur within area
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat known to occur within area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name

Commonwealth Land -
 Commonwealth Land - Airservices Australia
 Commonwealth Land - Australian Postal Commission
 Commonwealth Land - Australian Postal Corporation
 Commonwealth Land - Australian Telecommunications Commission
 Commonwealth Land - Defence Housing Authority
 Commonwealth Land - Defence Service Homes Corporation
 Commonwealth Land - Deputy Director of War Service Homes
 Commonwealth Land - Director of War Service Homes
 Commonwealth Land - Overseas Telecommunications Commission (Australia)
 Commonwealth Land - Telstra Corporation Limited
 Defence - 1CAD ORCHARD HILLS KINGSWOOD
 Defence - AIRTC ST MARYS
 Defence - BRINGELLY RADIO RECEIVING STATION
 Defence - PENRITH DEPOT (Army Stores)
 Defence - RANMME (DEOH)
 Defence - SIGNAL STRS DEPOT-KINGSWOOD

Commonwealth Heritage Places

[\[Resource Information \]](#)

Name	State	Status
Natural		
Orchard Hills Cumberland Plain Woodland	NSW	Listed place
Shale Woodland Llandilo	NSW	Listed place

Listed Marine Species

[\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species

Name	Threatened	Type of Presence
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	habitat known to occur within area Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Kemps Creek	NSW
Mulgoa	NSW
Wianamatta	NSW

Invasive Species	[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.	

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species

Name	Status	Type of Presence
Lepus capensis Brown Hare [127]		habitat likely to occur within area Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom,		Species or species

Name	Status	Type of Presence
Common Broom, French Broom, Soft Broom [20126]		habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

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

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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

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

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.78641 150.77059,-33.80112 150.76826,-33.81246 150.77564,-33.82041 150.77606

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Annexure E

MNES Assessments of Significance

Significant Impact assessment for vulnerable species - Grey-headed Flying-fox

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Criteria	Response
A) Lead to a long-term decrease in the size of an important population of a species	No impacts on breeding or roosting habitat for the Grey-headed Flying-fox are expected to result from the proposal as breeding/roosting camps do not occur in the proposal area and therefore would not be impacted.
B) Reduce the area of occupancy of an important population	About 9.38 hectares of potential foraging habitat would be cleared and therefore impacted by the proposal. The foraging habitat present is considered to be of low quality and consists of narrow areas of roadside remnant and regenerating woodland. Multiple flowering Eucalyptus species are present within proposed impact areas, some of which may contribute to winter and spring food resources. The significance of this contribution is not expected to be high as similar foraging habitat of higher quality occurs within the locality and the Grey-headed Flying Fox is a highly mobile species. Additionally, the proposal would not result in a significant reduction in the availability of potential foraging habitat within the locality, and the currently proposed removal of foraging habitat is not expected to cause a long-term decrease in the size of any population of the species.
C) Fragment an existing important population into two or more populations	The proposal is unlikely to increase fragmentation for any population of the species, as the Grey-headed Flying Fox is a highly mobile species and the proposal will not present as a barrier to movement of Grey-headed Flying Fox within the region. The proposal would not impact on areas where the species is known to breed and roost.
D) Adversely affect habitat critical to the survival of a species	<p>Habitat critical to the survival of the species has been loosely nominated within DECCW (2009) Draft National Recovery Plan for the Grey-headed Flying-fox. The Draft plan contains a definition for critical foraging habitat, and critical roosting habitat which have been addressed below:</p> <p>Critical Roosting Habitat</p> <p>DECCW (2009) states that habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying-foxes. Roosting habitat that:</p> <ol style="list-style-type: none"> 1. Is used as a camp either continuously or seasonally in > 50% of years <p>The proposal area and immediate surrounds are not presently or historically used as a camp site.</p> <ol style="list-style-type: none"> 2. Has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration (i.e. in the order of days rather than weeks or months) <p>As above.</p> <ol style="list-style-type: none"> 3. Has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May). <p>As above.</p>

Criteria	Response
	<p>Critical Foraging Habitat</p> <p>DECCW (2009) states that foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying Foxes. Natural foraging habitat that is:</p> <ol style="list-style-type: none"> 1. Productive during winter and spring, when food bottlenecks have been identified (ParryJones and Augee 1991, Eby et al. 1999): Eucalyptus species within the proposal area have been recorded flowering in the winter months, however this is unlikely to be a reliable occurrence such that it constitutes a productive food source during food bottlenecks. The proposal area may be used on occasion for foraging given the species feeds on a variety of eucalypts. 9.38 ha of potential foraging habitat occurs within the proposal area however, higher quality potential foraging habitat is available in the locality which would not be impacted by the proposal. Given that the potential foraging habitat within the proposal area constitutes such a small area of low quality roadside vegetation, is unlikely to be significantly productive during both winter and spring to an extent that it is critical foraging habitat for the species. 2. Known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult) The proposal area does not support a population of >30,000 individuals. 3. Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May) The proposal area is highly unlikely to be productive for the species given absence of roost sites, and the presence of higher quality foraging habitat elsewhere in the locality that will not be impacted by the proposal. 4. Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions) The proposal area is highly unlikely to be productive for the species given absence of roost sites, and the presence of higher quality foraging habitat elsewhere in the locality that will not be impacted by the proposal. No commercial crops or important commercial fruit trees would be impacted by the proposal. 5. Known to support a continuously occupied camp No camp sites occur within the proposal area.
D) Disrupt the breeding cycle of an important population	The proposal is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within camps, none of which would be adversely impacted by the proposal.
E) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the occurrence of large areas of higher quality foraging habitat within the locality. The proposal would not isolate areas of foraging habitat.
F) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	<p>The proposal is unlikely to increase the likelihood of weeds being established in areas adjacent to impact areas that constitute potential foraging habitat for the species. The disturbance area is an existing road, which is in itself a mechanism for the introduction and spread of weeds in the proposal area. Widening of this road is unlikely to significantly increase weed spread. The proposal will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan.</p> <p>Potential invasive predators such as the fox are likely to be already present within the proposal area and the proposal is not expected to increase the level of predation threat for the Grey-headed Flying-fox.</p>
G) Introduce disease that may cause the species to decline, or	There are no known documented diseases that are currently contributing to the decline of the species. The proposal is not expected to cause an increase in risk of any bat diseases.

Criteria	Response
H) Interfere substantially with the recovery of the species.	The proposal does not directly or substantially interfere with any of the specific recovery objectives under the draft National Recovery Plan (Commonwealth of Australia 2017). A general objective is to lessen the currently operating threats to the species which includes the removal of foraging habitat. The proposal is therefore not consistent with this general objective. However, the amount and type of foraging habitat removal is not considered to constitute substantial interference with the recovery of the species.
<p>Conclusion: Based on the assessment completed, we concluded that the proposal is unlikely to result in a significant impact due to the following:</p> <ul style="list-style-type: none"> • No Grey-headed Flying Fox camp sites occur within the proposal area or immediate surrounds • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size, and • Higher quality foraging habitat occurs elsewhere in the locality, including within protected areas. 	

Significant Impact assessment for listed migratory species - Yellow Wagtail

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

Criteria	Response
A) Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species, or	No important habitat for any of the potentially occurring migratory species is considered likely to occur within the proposal area, as such, no important areas of habitat will be substantially modified, destroyed or isolated.
B) Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	No important habitat for any of the potentially occurring migratory species is considered likely to occur within the proposal area, and no invasive species of particular significance to the identified migratory species are expected to become established as a result of the proposal. The proposal area is already affected by invasive plants including some high threat weeds and introduced fauna such as the Cat which have potential to adversely impact most fauna occurring within the proposal area and surrounds. New invasive species are unlikely to become established due to the proposal if mitigation measures are adhered to, including pest and weed management.
C) Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	None of the potentially occurring migratory species would have a significant proportion of their population occurring within the proposal area or utilise the site for a significant proportion of breeding, feeding, migration or resting activity. The Yellow Wagtail does not breed in Australia. Cattle Egrets may breed in wetlands adjacent to the proposal area however, it is unlikely this habitat would be utilised for breeding due to the proximity to the road, high level of noise and light pollution, and the abundance of higher quality wetland habitat present in other parts of the Penrith LGA.
<p>Conclusion: The Proposal would remove 9.38 hectares of native vegetation, which predominantly consists of small areas of remnant and regenerating roadside woodland, drainage lines, and farm dam adjacent areas. None of the above species occur in significant numbers within the proposal area and the proposal area does not support significant breeding habitat such that it may be used by a significant number of individuals to conduct any aspect of their lifecycle including foraging, breeding, overwintering or sheltering. The proposal is not likely to result in a significant impact on the Yellow Wagtail.</p>	

Significance Assessment for Cumberland Plain Woodland

Criteria	Response
<p>A. Reduce the extent of an ecological community</p>	<p>Based on validated vegetation mapping, about 3.63 hectares of Cumberland Plain Woodland that meets the Commonwealth definition of the ecological community will be impacted by the proposal.</p> <p>The validated Cumberland Plain Woodland in the construction footprint occurs as fragmented patches adjacent to Mamre Road or within paddocks. It presents as small, modified patches of woodland and/or scattered clumps of trees.</p> <p>The TEC in the construction footprint is characterised by a canopy of <i>Eucalyptus moluccana</i> (Grey Box) and <i>Eucalyptus tereticornis</i> (Forest Red Gum). The understorey has been highly modified by a history of edge effects and disturbance from land clearing, agricultural activities and weed invasion. Similar condition patches of Cumberland Plain Woodland occur adjacent to the construction footprint (within the BioBank site), and in the Locality as shown in Figure 11.</p> <p>The proposal may result in indirect impacts, such as causing further changes to local hydrological processes, increasing weed invasion and other edge effects in surrounding remnants of Cumberland Plain Woodland. However, any indirect impacts will be managed by the implementation of mitigation measures, which, when implemented, should ameliorate indirect impacts and minimise impacts to Cumberland Plain Woodland within the locality.</p> <p>The local occurrence of Cumberland Plain Woodland mapped by NPWS (2013) totals about 20 hectares, and occurs in varied conditions. Most of which is considered likely to align to the Commonwealth CEEC listing (excludes local occurrences of low condition or derived native grassland, which do not meet the commonwealth definition of the TEC).</p> <p>Cumberland Plain Woodland is preserved to the west of the proposal area within the Orchard Hills Defence Establishment Biodiversity Offset Delivery Plan.</p> <p>It is estimated that the proposal would result in a 12 per cent reduction to the current local occurrence of Cumberland Plain Woodland.</p>
<p>B. Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines</p>	<p>The vegetation within the construction footprint has been fragmented by existing road infrastructure, past land-clearing and agricultural activities. The proposal will marginally increase fragmentation by widening Mamre Road within the existing road reserve.</p> <p>Due to the fragmentation, the construction footprint is connected to Cumberland Plain Woodland in the locality via scattered remnants to the west, which predominantly occurs in paddocks.</p> <p>Whilst the proposal will further reduce the eastern edge of the locality where Cumberland Plain Woodland occurs in a moderate condition, the proposed works will not result in further isolation of a patch of Cumberland Plain Woodland.</p>
<p>C. Adversely affect habitat critical to the survival of an ecological community</p>	<p>The proposal occurs within a highly degraded and fragmented landscape, attributed to road infrastructure, residential development and agricultural practices. For most of the site (excluding the BioBank) the intensity and duration of disturbance to the Cumberland Plain Woodland habitat in the construction footprint is considered to be sufficient to have permanently altered the composition of remaining Cumberland Plain Woodland and significantly impaired the re-establishment of Cumberland Plain Woodland. This is evident in the relatively low native species diversity and high abundance of exotic species recorded in the plot and transect data collected by Aurecon (2020) and Niche. The Cumberland Plain Woodland within the proposal area lacks resilience such that if it were left without any active restoration and management, it is considered likely that the condition of the vegetation in construction footprint would continue to decline.</p> <p>A total of about 3.63 hectares of vegetation of varied conditions (Figure 6) occurs within the locality, of which most is considered likely to align to the Commonwealth CEEC listing. The proposal would result in a 12 per cent reduction to the current local occurrence of Cumberland Plain Woodland.</p>

Criteria	Response
<p>D. Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns</p>	<p>A total of 3.63 hectares of Cumberland Plain Woodland within the construction footprint would be cleared.</p> <p>Based on our understanding of the proposal, we anticipate that all indirect impacts associated with hydrology or erosion would be managed in the design, operation and construction, to ensure minimal impacts to surrounding vegetation.</p>
<p>E. Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting</p>	<p>The Cumberland Plain Woodland within the construction footprint is already in a moderate condition.</p> <p>In relation to indirect impacts to Cumberland Plain Woodland within the locality that may occur as a result of the proposal, the proposal area occurs within a highly degraded and fragmented landscape. For most of the site (excluding the BioBank) the intensity and duration of disturbance on the Cumberland Plain Woodland habitat in the construction footprint is considered to be sufficient to have permanently altered the composition of remaining Cumberland Plain Woodland and significantly impaired the re-establishment of Cumberland Plain Woodland. The exchange of genetic material and available seed bank from within the construction footprint is likely to be quite low, and therefore is not of great importance to the persistence of Cumberland Plain Woodland within the locality. Therefore, it is unlikely that the proposed works will substantially impact upon species composition and viability within the locality.</p>
<p>F. Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or</p>	<p>The Cumberland Plain Woodland within the construction footprint is already in a low to moderate condition state, as is evident in the relatively low native species diversity and high abundance of exotic species recorded in the plot and transect data collected by Aurecon (2020) and Niche.</p> <p>The Cumberland Plain Woodland within the proposal area lacks resilience such that if it were left without any active restoration and management, it is considered likely that the condition of the vegetation in construction footprint would continue to decline. The exchange of genetic material and available seed bank from within the construction footprint is likely to be quite low, and therefore is not of great importance to the persistence of Cumberland Plain Woodland within the locality.</p> <p>Furthermore, good condition patches of Cumberland Plain Woodland within protected areas in the locality provide genetic material and a viable seed source, and would not be impacted by the proposal.</p> <p>A range of mitigation measures would be implemented to minimise indirect impacts associated with the proposal. This would reduce the likelihood of invasive species from becoming established adjacent to the construction footprint.</p> <p>As such, it is considered that the proposal is unlikely to cause a substantial reduction the quality or integrity of the CEEC within the locality.</p>
<p>G. Interfere with the recovery of an ecological community</p>	<p>The proposal would interfere with the recovery of the community as it would result in the removal of Cumberland Plain Woodland. However, the viability of the CEEC to be cleared is low given the extensive history of disturbance and permanently altered composition that resulted. Further, the condition is considered likely decline overtime without active management. As such the proposal would not impact on any areas of Cumberland Plain Woodland that are important to the recovery of the ecological community.</p>
<p>Conclusion: Based on the assessment completed, we concluded that the proposal is may result in a significant impact due to the following:</p> <ul style="list-style-type: none"> • About 3.63 ha of the CEEC would be directly impacted by the proposal <p>The Cumberland Plain Woodland to be impacted is already fragmented and is in a degraded condition state</p> <ul style="list-style-type: none"> • The Cumberland Plain Woodland to be removed will not adversely affect habitat critical to the survival of an ecological community, and • The Cumberland Plain Woodland to be removed is unlikely to be an important source of genetic diversity or viable seed for the persistence of the ecological community within the locality. 	

Significance Assessment for River-flat Eucalypt Forest

Criteria	Response
<p>A. Reduce the extent of an ecological community</p>	<p>Based on validated vegetation mapping, about 2.84 hectares of River-flat Eucalypt Forest that meets the Commonwealth definition of the ecological community will be removed for the proposal.</p> <p>The validated River-flat Eucalypt Forest in the construction footprint occurs as fragmented patches adjacent to Mamre Road or within paddocks. It presents as small, modified patches of forest. River-flat Eucalypt Forest in the construction footprint (within the BioBank) is connected via a riparian corridor to intact vegetation found in the Defence Establishment in Orchard Hills.</p> <p>The TEC in the construction footprint is characterised by a canopy of <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>Angophora floribunda</i> (Rough-barked Apple). The understorey has been highly modified by a history of edge effects and disturbance from land clearing, agricultural activities and weed invasion. Similar condition patches of River-flat Eucalypt Forest occur adjacent to the construction footprint.</p> <p>The proposal may result in indirect impacts, such as causing further changes to local hydrological processes, increasing weed invasion and other edge effects in surrounding remnants of River-flat Eucalypt Forest. However, any indirect impacts will be managed by the implementation of mitigation measures, which, when implemented, should ameliorate indirect impacts and minimise impacts to River-flat Eucalypt Forest within the locality.</p> <p>The local occurrence of River-flat Eucalypt Forest mapped by DPIE is about 70 ha (Figure 2). Most of which is considered likely to align to the Commonwealth EEC listing (excludes local occurrences of low condition or derived native grassland, which do not meet the commonwealth definition of the TEC). River-flat Eucalypt Forest is preserved to the west of the proposal area within the Orchard Hills Defence Establishment Biodiversity Offset Delivery Plan. Additionally, intact River-flat Eucalypt Forest occurs in the western Sydney Parklands to the east of the proposal area which zoned as E2 – Environmental Conservation under the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (SEPP, SRGC).</p> <p>It is estimated that the proposal would result in a 2 % percent reduction to the current local occurrence of River-flat Eucalypt Forest.</p> <p>Therefore, whilst the removal of River-flat Eucalypt Forest associated with the Proposal would result in a small reduction of the local occurrence, the TEC will continue to exist within the locality. Thus, the reduction in extent is unlikely to be a significant impact such that it threatens the long-term persistence of River-flat Eucalypt Forest in the locality.</p>
<p>B. Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines</p>	<p>The vegetation associated with the proposal has been fragmented by existing road infrastructure, past land-clearing and agricultural activities. The proposal would marginally increase fragmentation by widening Mamre Road within the existing road reserve. River-flat Eucalypt Forest in the construction footprint is connected to larger patches of vegetation via riparian corridors.</p> <p>Whilst the proposal will further reduce the eastern edge of the locality where River-flat Eucalypt Forest occurs in a moderate condition, the proposed works would not result in further isolation of any patches of River-flat Eucalypt Forest.</p> <p>Given the current condition of the vegetation in the construction footprint, and its location adjacent to Mamre Road and paddock vegetation, it's considered that the marginal increase in fragmentation associated with the proposal would not significantly impact the EEC in the locality.</p>

Criteria	Response
<p>C. Adversely affect habitat critical to the survival of an ecological community</p>	<p>The proposal occurs within a highly degraded landscape, attributed to road infrastructure, residential development and agricultural practices. For most of the site (excluding the BioBank) the intensity and duration of disturbance to the River-flat Eucalypt Forest habitat in the construction footprint is considered to be sufficient to have permanently altered the composition of remaining River-flat Eucalypt Forest and significantly impaired the re-establishment of River-flat Eucalypt Forest. This is evident in the relatively low native species diversity and high abundance of exotic species recorded in the plot and transect data collected by Aurecon (2020) and Niche. The River-flat Eucalypt Forest within the proposal area lacks resilience such that if it were left without any active restoration and management, it is considered likely that the condition of the vegetation in construction footprint would continue to decline.</p> <p>A total of about 70 hectares of similar TEC occurs within the locality, of which most is considered likely to align to the Commonwealth EEC listing. The proposal would result in a 2% reduction to the current local occurrence of River-flat Eucalypt Forest.</p>
<p>D. Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns</p>	<p>A total of 2.84 hectares of River-flat Eucalypt Forest within the construction footprint would be cleared.</p> <p>Based on our understanding of the proposal, we anticipate that all indirect impacts associated with hydrology or erosion would be managed in the design, operation and construction, to ensure minimal impacts to surrounding vegetation.</p>
<p>E. Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting</p>	<p>The River-flat Eucalypt Forest within the construction footprint is already in a moderate condition.</p> <p>In relation to indirect impacts to River-flat Eucalypt Forest within the locality that may occur as a result of the proposal, the subject area occurs within a highly degraded landscape. For most of the site (excluding the BioBank) the intensity and duration of disturbance on the River-flat Eucalypt Forest habitat in the construction footprint is considered to be sufficient to have permanently altered the composition of remaining River-flat Eucalypt Forest and significantly impaired the re-establishment of River-flat Eucalypt Forest. The exchange of genetic material and available seed bank from within the construction footprint is likely to be quite low, and therefore is not of great importance to the persistence of River-flat Eucalypt Forest within the locality.</p> <p>Therefore, it is unlikely that the proposed works will substantially impact upon species composition of River-flat Eucalypt Forest within the locality.</p>
<p>F. Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or</p>	<p>The River-flat Eucalypt Forest within the construction footprint is already in a low to moderate condition, as is evident in the relatively low native species diversity and high abundance of exotic species recorded in the plot and transect data collected by Aurecon (2020) and Niche. The River-flat Eucalypt Forest within the proposal area lacks resilience such that if it were left without any active restoration and management, it is considered likely that the condition of the vegetation in construction footprint would continue to decline.</p> <p>A range of mitigation measures would be implemented to minimise indirect impacts associated with the proposal. This would reduce the likelihood of invasive species from becoming established adjacent to the construction footprint and minimise potential for the mobilisation of any chemical pollutants into the EEC as a result of the proposal.</p> <p>As such, it is considered that the proposal is therefore unlikely to cause a substantial reduction the quality or integrity of the EEC within the locality.</p>

Criteria	Response
G. Interfere with the recovery of an ecological community	The proposal would interfere with the recovery of the community as it will result in the removal of River-flat Eucalypt Forest. However, the viability of the EEC to be cleared is moderate and, given the extent of fragmentation and ongoing disturbances and edge effects, the condition of the EEC would likely decline overtime without active management. As such the proposal would not impact on good condition patches of River-flat Eucalypt Forest in the locality that are important to the recovery of the ecological community.
<p>Conclusion: Based on the assessment completed, we concluded that the proposal is unlikely to result in a significant impact due to the following:</p> <ul style="list-style-type: none"> • The River-flat Eucalypt Forest to be impacted is already fragmented and is in a degraded condition state • The River-flat Eucalypt Forest to be removed will not result adversely affect habitat critical to the survival of an ecological community, and • The River-flat Eucalypt Forest to be removed is unlikely to be important to support genetic diversity and a seed source for the locality. 	

Annexure F

BAM-C Credit Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00025463/BAAS20002/21/00025464	6634 Mamre rd upgrade	10/06/2021
Assessor Name	Report Created	BAM Data version *
Luke Baker	05/08/2021	45
Assessor Number	BAM Case Status	Date Finalised
BAAS17033	Open	To be finalised
Assessment Revision	Assessment Type	
1	Part 5 Activities	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
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Cumberland riverflat forest											
3	835_Moderate	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	72.4	72.4	2.8	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00		103
4	835_Low	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	27.6	27.6	1.5	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00		21
										Subtotal	124
Cumberland shale plains woodland											
1	849_Moderate	Cumberland Plain Woodland in the Sydney Basin Bioregion	48.6	48.6	3.6	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	110
2	849_Low	Cumberland Plain Woodland in the Sydney Basin Bioregion	7.6	7.6	0.92	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	0

										Subtotal	110
Cumberland Swamp Oak riparian forest											
5	1800_Moderate	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	36.1	36.1	0.47	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00		8
										Subtotal	8
										Total	242

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAI	Species credits	
<i>Meridolum corneovirens</i> / Cumberland Plain Land Snail (Fauna)									
849_Moderate		48.6	48.6	1.6	Endangered	Not Listed	2 False	38	
849_Low		7.6	7.6	0.41	Endangered	Not Listed	2 False	2	
835_Moderate		72.4	72.4	1.1	Endangered	Not Listed	2 False	41	
835_Low		27.6	27.6	0.19	Endangered	Not Listed	2 False	3	
1800_Moderate		36.1	36.1	0.13	Endangered	Not Listed	2 False	2	
								Subtotal	86
<i>Myotis macropus</i> / Southern Myotis (Fauna)									
849_Moderate		48.6	48.6	1.5	Vulnerable	Not Listed	2 False	37	
849_Low		7.6	7.6	0.07	Vulnerable	Not Listed	2 False	1	

BAM Credit Summary Report

835_Moderate	72.4	72.4	2.6	Vulnerable	Not Listed	2	False	94
835_Low	27.6	27.6	1.4	Vulnerable	Not Listed	2	False	20
1800_Moderate	36.1	36.1	0.47	Vulnerable	Not Listed	2	False	8
							Subtotal	160

