Reeves Street, Somersby

Biodiversity Certification Assessment Report

Prepared for Darkinjung Local Aboriginal Land Council

May 2025

Reeves Street, Somersby

Biodiversity Certification Assessment Report

Darkinjung Local Aboriginal Land Council

E230446 RP5

May 2025

Version	Date	Prepared by	Reviewed by	Comments
1	23 May 2025	Ireni Clarke Bianca Morton	Erin Lowe Cecilia Phu	FINAL for Council consultation

Approved by

Cecilia Phu
Associate Ecologist
23 May 2025

Level 10 201 Pacific Highway
St Leonards NSW 2065
ABN: 28 141 736 558

BDAR declaration

Certification under clause 6.15 Biodiversity Conservation Act 2016 and conflict of interest

I, Ireni Clarke, certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Signature: 

Date: 23/05/2025

BAM Assessor Accreditation no: BAAS25004

This BCAR has been prepared to meet the requirements of BAM 2020 (DPIE 2020a).

Actual, perceived or potential conflict of interest

It is noted that EMM is engaged to undertake work for both development and conservation (Stewardship) clients. There is the potential for actual, perceived or potential conflicts of Interest. This section discloses relevant information known at the time of preparation of this report to such considerations.

- EMM staff or relatives involved in the preparation of this report do not own, and were not aware of any other EMM staff or relative holding or having interests in Stewardship sites or any of the biodiversity credits identified as being required in this report.
- There were no debts to debts to the client or associates of the client.
- There were no known potential conflicts of interest between the client for this report with another client of EMM.

Details and experience of author/s and contributors

In this report an assessment of the biodiversity values and impacts associated with the proposal have been undertaken in accordance with the Biodiversity Assessment Method 2020 (DPIE 2020a). This Biodiversity Certification Assessment Report (BCAR) has been prepared by accredited assessors Ireni Clarke (BAAS25004), Cecilia Phu (BAAS17058) and Bianca Morton (BAAS23008). The credit calculations were performed by Bianca Morton (BAM-C application version 1.5; BAM data version 80). A technical review was completed by Erin Lowe (BAAS18135). A number of staff contributed to fieldwork and data collection as identified in the table below.

Contributors to the BCAR

Personnel	Qualifications	Experience	Contribution / Role
Ireni Clarke (Senior Ecologist)	BSc (Adv)(Hons) BAM accredited assessor (BAAS25004)	5 years	• Project Manager • BCAR lead author • Data analysis • Field surveys (flora and fauna)
Nathan Garvey (Associate Director)	BSc Grad Dip (Biological Science) CEnvP BAM accredited assessor (BAAS17037)	20+ years	• Project director • Technical advisor • Field surveys (swamp mapping and giant dragonfly surveys)

Personnel	Qualifications	Experience	Contribution / Role
Cecilia Phu (Associate Ecologist)	BSc (Hons) BAM accredited assessor (BAAS17058)	17 years	• Project director • Technical advisor • Technical review
Bianca Morton (Senior Ecologist)	BSc (Sustainable Resource Mgt and Marine Sc) Post Grad Dip (GIS) BAM accredited assessor (BAAS23008)	5 years	• BCAR reporting • Data analysis
Erin Lowe (Associate Ecologist)	BSc (Sustainable Resource Mgt) BNatHistIllus (Scientific Illustration) BAM accredited assessor (BAAS18135)	12 years	• Technical review
Hayden Beck (Associate Ecologist)	PhD (Ecology) MSc (Research) BEnvSc (Hons) BSc (Marine Science) BAM Accredited Assessor (BAAS19000)	9 years	• Vegetation mapping • Habitat assessments
Jason Brown (Associate Ecologist)	BSc (Env mgn/GeoSci) BAM Accredited Assessor (BAAS21017)	18 years	• Field surveys (fauna)
Ross Davey (Ecologist)	BSc	4 years	• Field surveys (Targeted flora survey, BAM plots)
Justin Chey (Ecologist)	BEnvScMgt (Sustainability)	5 years	• Field surveys (Targeted flora survey, BAM plots)
Amy Rowles	BSc (Honours)(Ecology)	26 years	• Anabat acoustic data analysis • Harp trapping surveys
Madeleine Hunt (Ecologist)	BEnvScMgt (Marine Science)	2 years	• Field surveys (Giant dragonfly surveys) • BCAR reporting
Paul Rossington (Associate Ecologist)	BSc (Biology) BAM Accredited Assessor (BAAS18065)	18 years	• Field surveys (Targeted flora surveys, BAM plots)
Zachary Blake (Graduate Ecologist)	BEnvScMgt MEnvMgtSustain	1 year	• BCAR reporting

Executive summary

ES1 Introduction

Darkinjung Local Aboriginal Land Council (Darkinjung) is lodging a planning proposal for the rezoning of Lot 481 DP 1184693, Reeves Street, Somersby NSW (the site). The proposal includes the rezoning of the lot from C2 (Environmental Conservation) and RU2 (Rural Landscape), to C4 (Environmental Living) and C2. An area of 13.39 hectares (ha) is being proposed for biodiversity certification (the subject land), aligning with the proposed C4 zoning on the site.

ES2 Location of the project

The site is located on the southern side of Reeves Street, Somersby, to the east of the Pacific Motorway in the Central Coast Local Government Area (LGA). The subject land sits within an area of intact native vegetation, with some rural landholdings to the north. The site is within a corridor of native vegetation connected to Strickland State Forest in the north. To the south, Debenham Road and the Central Coast Highway separate the site from Brisbane Waters National Park.

The subject land is in an area of Hawkesbury sandstone and supports a mix of shrubby woodland and heath vegetation communities, on a gentle southeast-facing slope. In areas of the site where hydrology is impeded, there are upland swamp heath communities, with little to no canopy cover and a dense ground cover of mesic species such as sedges and ferns. The vegetation in the subject land is generally in good condition with minimal disturbance evident, and provides potential habitat for a range of species, as reflected in the key findings of the assessment.

ES3 Purpose of this assessment

This Biodiversity Certification Assessment Report (BCAR) has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of Darkinjung to accompany the planning proposal. It assesses the potential biodiversity impacts of the rezoning on biodiversity values present within and adjacent to the subject land (area being proposed for biodiversity certification) following assessment methods outlined in the Biodiversity Assessment Method (BAM) (DPIE 2020a).

This report follows on from the Flora and Fauna Assessment (FFA) prepared by EMM in 2023 (EMM 2023a), as well as a previous BCAR completed for the site by Umwelt (Australia) Pty Limited (Umwelt) (2020).

ES4 Process

This assessment combines the work completed by Umwelt on the site from 2018 to 2020 with additional surveys and assessments completed by EMM. The subject land used by Umwelt in the previous BCAR (2020) has been revised. Data collected by Umwelt has only been applied to the new subject land where appropriate.

ES5 Results

ES5.1 Native vegetation

Field surveys identified four plant community types (PCTs) within the subject land, in varying conditions, outlined in Table ES1.

Table ES1 PCTs and vegetation zones within the subject land

PCT	Condition	Area (ha)
PCT 3586 – Northern Sydney Scribbly Gum Woodland	High	2.09
	Open	0.27
PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest	High	7.68
	Disturbed	0.24
	Pines	0.77
PCT 3807 – Northern Sydney Heath-Mallee	High	0.43
PCT 3924 – Sydney Coastal Upland Swamp Heath	High	1.83

ES5.2 Threatened ecological communities

One threatened ecological community (TEC) was identified within the subject land: Coastal Upland Swamp in the Sydney Basin Bioregion (Coastal Upland Swamp), with all areas of PCT 3924 considered to be consistent with the community. The TEC is listed as endangered under both the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A total of 1.83 ha of the TEC has been mapped within the subject land. This TEC was a key driver for the avoidance and minimisation measures taken for the site.

ES5.3 Threatened species

Seven threatened species were recorded within the subject land during surveys, including two flora species and five fauna species:

- Spreading Guinea Flower (*Hibbertia procumbens*)
- *Hibbertia puberula*
- Eastern Pygmy-possum (*Cercartetus nanus*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Giant Burrowing Frog (*Heleioporus australiacus*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Red-crowned Toadlet (*Pseudophryne australis*).

Species polygons have been generated for each of these species in order to calculate a credit requirement.

ES6 Avoidance and minimisation measures

Through redesigning of the planning proposal and the biocertification boundary, Darkinjung have sought to minimise impacts to the key biodiversity values present in the site. The main driver of the avoidance measures has been the areas of the Coastal Upland Swamps TEC. The current design of the subject land avoids 7.52 ha of the TEC compared to the design in the previous BCAR. Additionally, the design has focused on preserving the larger and more intact areas of Coastal Upland Swamp at the western end of the site.

The redesign process has also avoided 16.95 ha of native vegetation overall that was included in the original footprint. Avoidance and minimisation measures are outlined in more detail in Chapter 6 of this report.

ES7 Biodiversity offsets and strategy

The certification of the subject land will require the retirement of 309 ecosystem credits and 2,820 species credits.

The majority of the site will be rezoned to C2 and is intended to be used for conservation. As much as possible Darkinjung will be offsetting within the site by entering into a Biodiversity Stewardship Agreement (BSA).

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1 Introduction

The *Aboriginal Land Rights Act 1983* (ALR Act) puts in place an Aboriginal land claims system which enables Local Aboriginal Land Councils (LALCs) to make a claim (for ownership) of areas of Crown Land which are not needed for an essential public purpose, or for a range of other reasons set out in the ALR Act. This process has the effect of progressively returning to Aboriginal people the ownership of some of the land from which they were dispossessed.

Darkinjung Local Aboriginal Land Council (Darkinjung) made a successful land claim for Lot 481 DP 1184693, Reeves Street, Somersby NSW (the site) and the site was transferred to the ownership of Darkinjung through the Aboriginal land claims process.

The site was subsequently included in Darkinjung's Development Delivery Plan (DDP), prepared in accordance with State Environmental Planning Policy (Planning Systems) 2021 (SEPP) – Chapter 3 Aboriginal Land and in collaboration with NSW Department of Planning and Environment (DPE). The sites chosen for the DDP were selected through an extensive and considered process which addresses the requirements of the SEPP, including:

- the general objectives of the LALC for the land
- the nature of development proposed for the land
- the basis on which the development is proposed, having regard to applicable economic, social and environmental factors
- strategies, actions and a program for achieving the objectives for the land.

Consideration was also given to the Central Coast Regional Plan 2041 (DPE 2022e).

As part of the preliminary work related to the preparation of a DDP, Darkinjung completed an audit of its land to identify sites that appear suitable to deliver various cultural, economic, social and environmental benefits in-line with its Community, Land and Business Plan. Darkinjung representatives undertook a series of workshops with DPE officers to identify priority sites, including profiling opportunities and constraints.

A large proportion of land owned by Darkinjung was considered to have high conservation and cultural importance and has not been proposed for development and is not included in the DDP. Of the approximately 3,700 hectares (ha) of land that Darkinjung owns, the 31 sites in the DDP cover approximately 1,613 ha. Importantly, the sites included in the DDP also include significant areas of conservation land and those parts of the sites are proposed to be protected. This is a typical characteristic of lands granted to Local Aboriginal Land Councils. This means that to achieve the objects of the *NSW Land Rights Act 1984* impacts on land with environmental attributes are unavoidable. Nevertheless Darkinjung seeks a responsible and net environmentally positive approach to its overall activities.

The DDP process resulted in identification of 31 sites which Darkinjung have prioritised for future development to meet the needs of both the State of NSW and the Darkinjung community.

The Somersby site was identified in both the final DDP and the Interim DDP as a priority site for development in the short term. The site is mapped in State Environmental Planning Policy (Planning Systems) 2021 and is identified as a residential investigation area in the Narara district adjacent to the Somersby regionally significant growth area. The site provides an opportunity to develop low-scale rural residential dwellings and secure an east-west regional biodiversity corridor within an appropriate zoning.

1.1 Background

1.1.1 Project description

Darkinjung Local Aboriginal Land Council (Darkinjung) is seeking to lodge a planning proposal to rezone Lot 481 DP 1184693, Reeves Street, Somersby NSW (the site) for a mix of residential housing development and conservation.

The majority of the lot is currently zoned RU2 Rural Landscape with C2 Environmental Conservation along the eastern boundary (Figure 1.1). The planning proposal will seek to rezone land subject to future development to Environmental Living (C4) while remaining land will be rezoned to Environmental Conservation (C2) (Figure 1.2). The planning proposal provides for 14 residential allotments in the proposed C4 area. As part of a proposed modification to the planning proposal a change in the minimum lot size is being sought. This will not change the overall yield of 14 lots, but is necessary to provide for the reduction in the proposed C4 area to better protect biodiversity values as compared to the original proposal.

The proposed C4 zoning, where future residential subdivision will occur, has taken into account the key biodiversity constraints of the site, and has been located to minimise impacts to Coastal Upland Swamps in the Sydney Basin Bioregion endangered ecological community (EEC). The biodiversity assessment for the proposed rezoning has been carried out in parallel with the planning proposal and has informed the evolution of the design of the proposed rezoning. The area to be conferred for biodiversity certification (the subject land), has been placed within the northern portion of the site to minimise impacts to the EEC.

Darkinjung is seeking biodiversity certification (Biocertification) of the subject land in parallel with the planning proposal, with a view to having land proposed for future development biocertified prior to any future application for subdivision. Biocertification includes the preparation of this Biodiversity Certification Assessment Report (BCAR) and application to the Conservation Programs, Heritage and Regulation Division (CPHR), formerly the Biodiversity, Conservation and Science Directorate (BCS) of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) for biocertification. Biodiversity values in the remainder of the site (outside the subject land) have been considered as part of the conservation measures proposed in this BCAR.

The biodiversity values of the subject land are outlined in Chapters 4 and 5 of this report, and measures taken to avoid them are detailed in Chapter 6.

1.1.2 Site location

The site is located on the southern side of Reeves Street, Somersby, to the east of the Pacific Motorway in the Central Coast Local Government Area (LGA) (Figure 1.1).

The biodiversity certification assessment area for this assessment comprises the entire of Lot 481 Reeves Street, the area of land that is subject to the planning proposal. The majority of this lot will be rezoned to Environmental Conservation (C2).

The biodiversity assessment for the proposed rezoning has been carried out in parallel with and has informed the evolution of the design of the planning proposal. Multiple designs for the area proposed for biocertification have been considered. A previous iteration of the biocertification area has been used as the study area for the purposes of this assessment. Biodiversity data was collected across the study area, to inform the final placement of the biocertification boundary.

The area proposed for biocertification (subject land) is contained within the study area, placed along the northern boundary of the site, and includes sufficient area for residential development, asset protection zones (APZs) and a proposed fire trail. No internal roads are proposed. An overview of the proposed rezoning is shown in Figure 1.2.

The subject land covers an area of approximately 13.4 ha and is surrounded by a mix of intact native vegetation and rural landholdings. The native vegetation within the site is connected to Strickland State Forest in the north. To the south, Debenham Road and the Central Coast Highway separate the site from Brisbane Water National Park.

1.2 Key terminology

Table 1.1 Key terms used in this report

Term	Definition
The proposed rezoning	The proposed rezoning of Lot 481 Reeves Street, Somersby to a combination of C2 and C4 zones.
Biodiversity certification assessment area/'the site'	Lot 481 Reeves Street, Somersby. This is the area of land to which the planning proposal applies, and includes the subject land (proposed certified land), the study area, and surrounding areas within the lot.
Study area	The area of land that was assessed in detail as part of this report.
Subject land	The area of land proposed for biodiversity certification. The area will comprise future proposed residential lots, which will include asset protection zones (APZ) and a fire trail.

1.3 Purpose of this report

This BCAR assesses the potential biodiversity impacts of the proposed rezoning, allowing for future residential development within the subject land, following assessment methods outlined in the Biodiversity Assessment Method (BAM) (DPIE 2020a). It has been prepared to accompany the planning proposal and follows on from the Flora and Fauna Assessment (FFA) prepared by EMM in 2023 (EMM 2023a). Since the submission of the FFA, additional field surveys and assessments have been carried out in order to meet the requirements of a BCAR, and the area of the subject land has been reduced.

The report combines the work completed by Umwelt (Australia) Pty Limited (Umwelt) on the site from 2018 to 2020 (Umwelt 2020), with the more recent assessments completed by EMM. The study area used by Umwelt has since been revised, so the data collected by Umwelt has only been applied to the new study area where appropriate.

1.4 Information sources

1.4.1 Publications and databases

In order to provide context for the proposed rezoning, information about flora and fauna species, populations, communities and habitats from the locality was obtained from the following publications and databases:

- NSW BioNet for:
  - Atlas of NSW Wildlife for threatened species records
  - threatened species profiles
  - threatened biodiversity data collection (TBDC)
  - Vegetation Classification database for information on plant community types (PCTs).

- Commonwealth Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) likely to occur within the study area
- Commonwealth DCCEEW Species Profile and Threats Database (DCCEEW 2023a)
- Interactive Flying-fox web viewer (DCCEEW 2021)
- New South Wales Flora Online (PlantNET; Royal Botanic Gardens and Domain Trust n.d.)
- Register of Areas of Outstanding Biodiversity Value (AOBV) (DPE 2022a)
- NSW WeedWise (DPI 2023).

1.4.2 Other relevant reports

This assessment has been prepared with reference to the previous work and reports completed by Umwelt, prepared in earlier stages of this proposed rezoning and for other similar projects in the region, including:

- *Biodiversity Certification Assessment Report – Reeves Street, Somersby* (Umwelt 2020)
- *Flora and fauna assessment – Reeves Street, Somersby* (EMM 2023a).

1.4.3 Spatial data

Spatial data encompassing the study area, including the proposed rezoning, lot layout, APZ locations et cetera, were obtained from Darkinjung and Coastal Planning and Consulting Pty Ltd. Data on previous flora and fauna surveys, including survey locations and records of threatened species, was obtained from Umwelt.

The following spatial datasets were reviewed in the development of this report:

- Mitchell Landscapes Version V3.1 (OEH 2017)
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DoEE 2018)
- NSW State Vegetation Type Map vC2.0.M2.0 (NSW DCCEEW 2023a)
- Directory of important wetlands in Australia (DIWA) (DAWE 2021)
- Australian Ramsar Wetlands (DAWE 2022a)
- LiDAR derived canopy height model (CHM) and digital elevation model (DEM) (client supplied).

Mapping undertaken during the site assessment was conducted using a hand-held GPS unit, mobile tablet computers running ArcGIS Field Maps™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ± 5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.8.1).

1.4.4 Imagery

Imagery relied upon in this BAM assessment include those sourced from:

- SIX Maps Viewer (Department of Customer Service – Spatial Services)
- ESRI – map service layer (Esri, Maxar, Earthstar Geographics, and the GIS User Community)
- Metromaps (© Aerometrex 2021).

1.5 Consultation

EMM has consulted with the former NSW DPE and with Central Coast Council as part of the planning proposal process for the rezoning at Reeves Street, alongside Coastal Planning and Consulting Pty Ltd who are preparing the planning proposal. The FFA (EMM 2023a) was subsequently prepared to accompany the planning proposal and to facilitate consultation on biodiversity issues at the site.

In response to the FFA, EMM received recommendations for the ongoing biodiversity assessment of the site from CPHR (correspondence dated 14 August 2023) and Central Coast Council (correspondence dated 9 August 2023). These recommendations have been considered and have been incorporated into this BCAR in the appropriate sections.

KEY

- Biodiversity Certification Assessment Area (Lot boundary)
- Subject land
- Study area

Existing environment

- Watercourse/drainage line
- Cadastral boundary
- State Forest

Current zoning –

Gosford Local Environmental Plan 2014

- C2 | Environmental Conservation
- RU2 | Rural Landscape

INSET KEY

- Major road
- NPWS reserve
- State forest

The site

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
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Figure 1.1

X:\2023\E230446 - Reeves Street, Somersby Biocertification\GIS\02 Maps\G001 ProjectArea 20241119 04.mxd 21/11/2024

Source: EMM (2024); ABS (2021); DCSSS (2024); GA (2009); MetroMap (2024)

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GDA2020 MGA Zone 56

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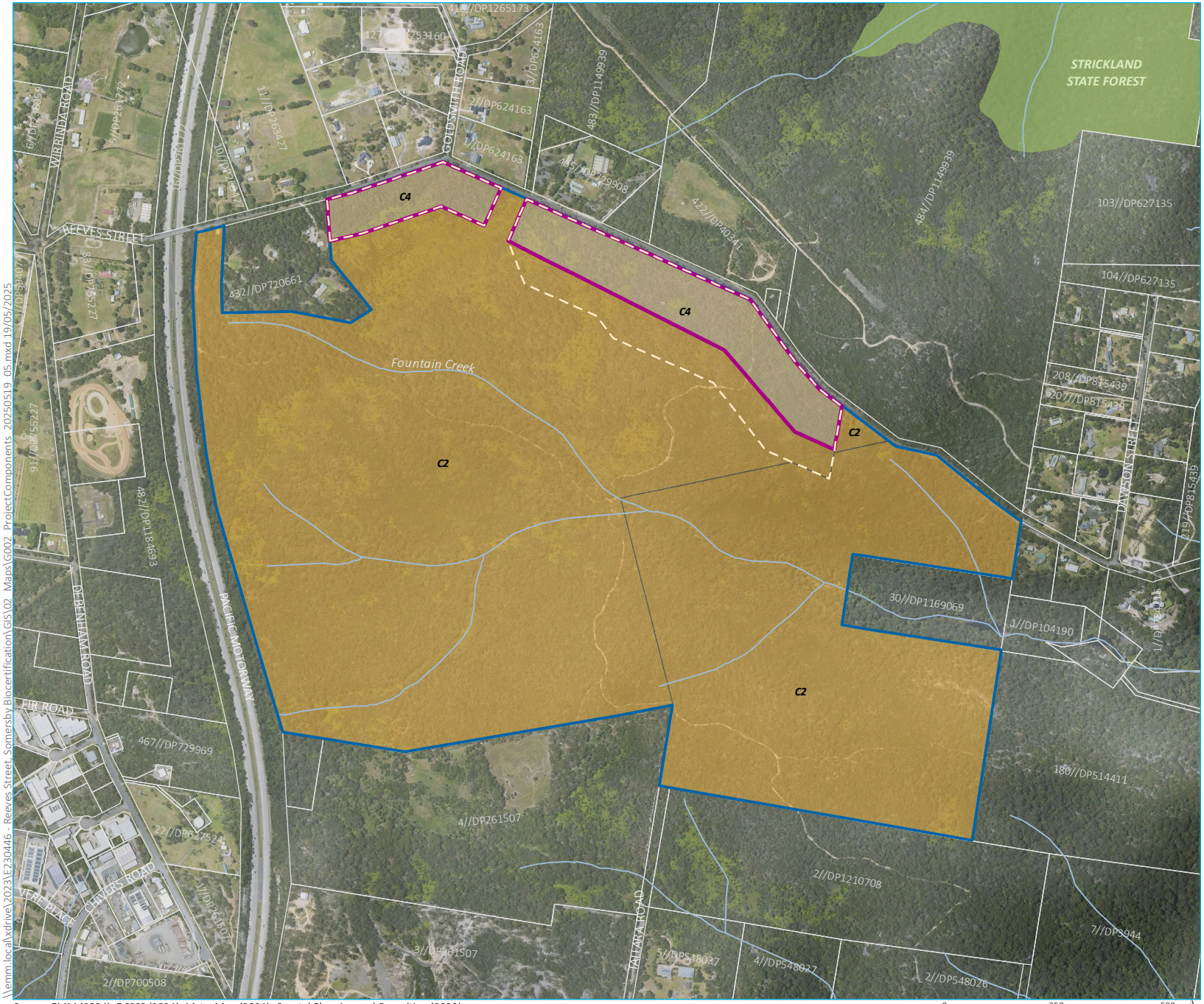

Proposed rezoning

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Figure 1.2

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2 Legislation

2.1 State

2.1.1 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning, Housing and Infrastructure (DPHI).

The EP&A Act provides the overarching structure for planning in NSW; however, it is supported by other statutory environmental planning instruments (EPIs) including State Environmental Planning Policies (SEPPs). As the proposed rezoning does not involve a development application, no EPIs are relevant to this report.

2.1.2 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the BAM (Biodiversity Assessment Method, DPIE 2020a) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on biodiversity. The BAM provides a framework to assess native vegetation as well as threatened species and threatened ecological communities, and their habitats, and determine offset requirements.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- identify the biodiversity values on land subject to proposed development area
- determine the impacts of a proposed development, following all measures to avoid, minimise and mitigate impacts
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM.

Part 8 of the BC Act sets out a method for Biocertification of land, with the effect of Biocertification being that:

> A consent authority, when determining a development application in relation to development on biodiversity certified land under Part 4 of the *Environmental Planning and Assessment Act 1979*, is not required to take into consideration the likely impact on biodiversity of the development carried out on that land
>
> (Section 8.4 of the BC Act).

As outlined above, Darkinjung intends to seek Biocertification of the land proposed for rezoning to C4.

2.2 Commonwealth

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as Matters of National Environmental Significance (MNES) under the EPBC Act. These are:

- World Heritage properties
- places listed on the National Heritage Register
- Ramsar wetlands of international significance
- threatened flora and fauna species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to Commonwealth DCCEEW for determination as to whether or not it is a controlled action. If deemed a controlled action, the proposed rezoning is assessed under the EPBC Act and a decision made as to whether or not to grant approval.

No development is proposed at planning proposal stage and as such there is no requirement to refer an action to the Commonwealth Minister. Notwithstanding, biodiversity values listed as MNES are relevant to this BCAR and so an assessment of the proposed rezoning against the EPBC Act is provided in Chapter 9.

Stage 1 – Biodiversity assessment

3 Landscape context

3.1 Landscape features

The identification of landscape features was undertaken in accordance with Section 3 of the BAM (DPIE 2020a), and results are summarised in Table 3.1 below and shown in Figure 3.1.

Table 3.1 Landscape features

Landscape feature	Presence within the subject land
Method applied for site context components	1,500 m buffer area
IBRA bioregion	Sydney Basin
IBRA subregion	Pittwater
BioNet NSW landscapes (formerly Mitchell landscapes)	Somersby Plateau
Rivers, streams and estuaries	The subject land does not support any waterways. Fountain Creek is located within the site, to the south of the subject land. The creek flows west to east, starting as a first order stream at the western edge of the site, and is mapped as second order at the eastern boundary of the site.
Wetlands	Brisbane Water estuarine wetland is located approximately 3.5 km south-east of the subject land.
Connectivity of different areas of habitat	The native vegetation within the site is connected to Strickland State Forest in the north and Brisbane Water National Park to the south. Reeves Street itself separates the vegetation within the site from the state forest, and Debenham Road and the Central Coast Highway fragment the site from the National Park.
Areas of geological significance and soil hazard	Clifflines were identified within the 1,500 m buffer area to the southeast and northeast of the subject land which may support areas of geological significance. Rocky areas situated above the cliffline to the southeast of the subject land were investigated during habitat assessments and these did not contain crevices, caves or overhangs.
Areas of outstanding biodiversity value	None identified

3.2 Assessment of site context

3.2.1 Native vegetation cover

The site context has been assessed in accordance with Section 3.2 of the BAM (DPIE 2020a) for site-based developments.

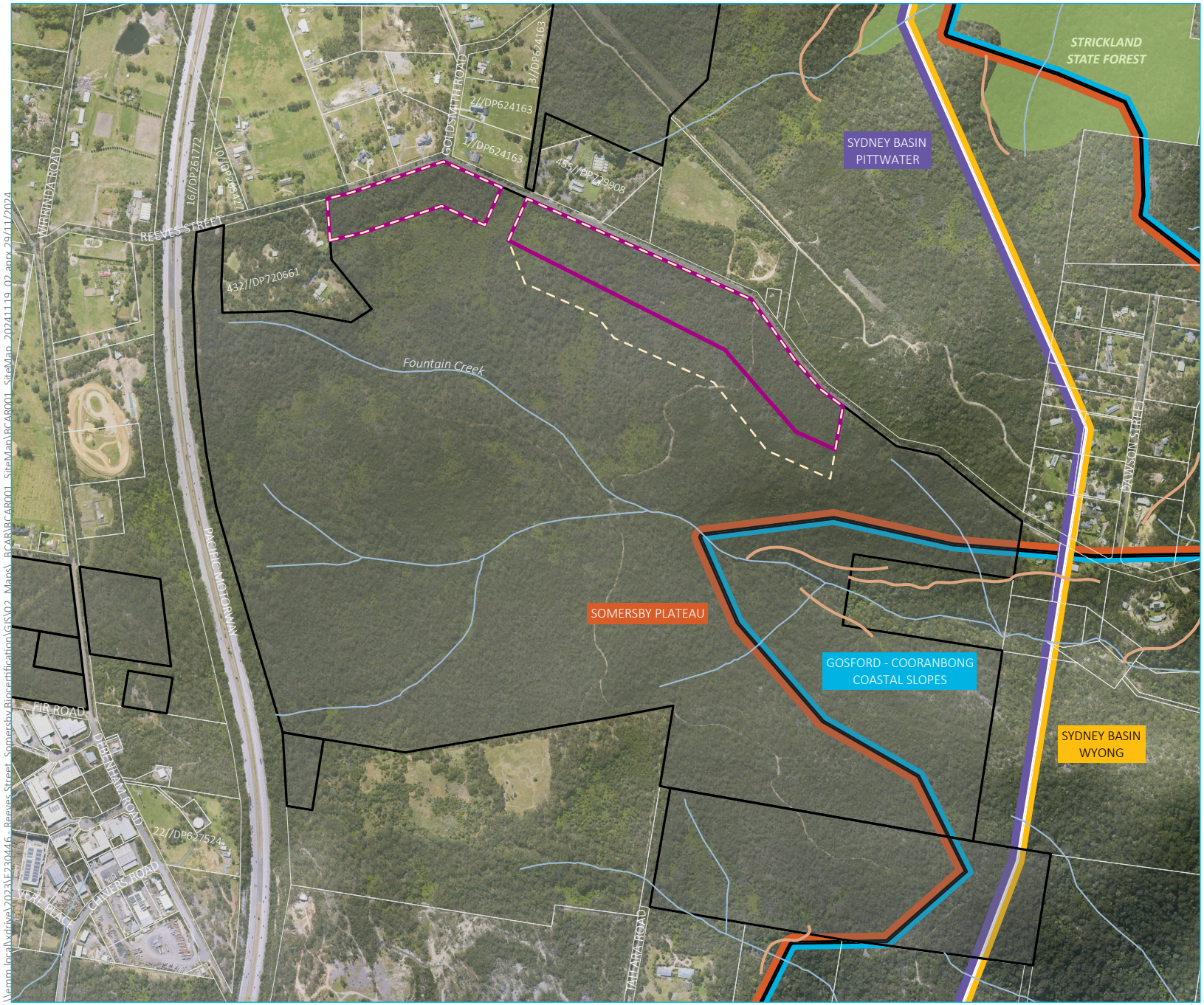
Regional mapping data (NSW State Vegetation Type Map) was used as a starting basis for estimating native vegetation extent (NSW DCCEEW 2023a). In areas where vegetation mapping was validated by ground-truthing and plot surveys (i.e. within the study area), this information was used to determine native vegetation extent instead of the regional mapping data (Figure 3.2).

Table 3.2 Percentage native vegetation cover

Native vegetation in 1,500 m assessment area (ha)	1,500 m assessment area (ha)	Approximate percentage of native vegetation in 1,500 m assessment area (nearest 2dp)	Cover class (BAM Section 3.2 (3.))
905.92	1143.39	79.23	d. >70%

3.2.2 Patch size

Patch size was assumed to be >100 ha for every vegetation zone mapped within the subject land as all vegetation zones are connected to more extensive areas of native vegetation in multiple directions. This conservative approach to threatened species assessment enabled the BAM-C to filter in the maximum number of candidate species for consideration.



KEY

- Subject land
- Study area
- Cliffline

Existing environment

- Watercourse/drainage line
- Cadastral boundary
- Darkinjung owned land
- State forest

IBRA 7 region | subregion

- Sydney Basin | Pittwater
- Sydney Basin | Wyong

Mitchell landscape

- Gosford - Cooranbong Coastal Slopes
- Somersby Plateau

Source: EMM (2024); DCSSS (2023); DCCEEW (2024); OEH (2017); Esri (2024)

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GDA2020 MGA Zone 56

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Site map

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
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Figure 3.1

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Source: EMM (2024); DCSSS (2023); DCCEEW (2024); OEH (2017); Esri (2024)

Location map

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
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Figure 3.2

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4 Native vegetation

4.1 Background review

A review of desktop information was undertaken to obtain a broad understanding of the regional vegetation types within the locality of the study area. This included a review of the following data sources and reference literature:

- PCT mapping completed by Umwelt (2020)
- NSW State Vegetation Type Map vC2.0.M2.0 (NSW DCCEEW 2023a)
- BioNet PCT Lineage History Data for conversion of former PCTs to revised PCTs and associated threatened ecological communities (TECs)
- PCT mapping completed by EMM as part of the FFA (EMM 2023a).

Native vegetation at the site was assessed by Umwelt in 2020. Umwelt's assessment included BAM plots and the development of a PCT map. Three PCTs were identified by Umwelt within the study area, split into four vegetation zones to include a range of condition states.

Revised PCTs for eastern NSW have been introduced since the completion of Umwelt's assessments. EMM converted the PCTs mapped by Umwelt to the revised PCTs using lineage information in the BioNet Vegetation Classification database as part of the FFA (EMM 2023a). The new PCTs present in the study area aligned with the PCTs identified in the State Vegetation Type Map, although extent and boundaries between PCTs were different. PCTs were validated during field surveys as part of the FFA process in order to produce the vegetation mapping for the FFA. More extensive vegetation surveys have since been completed as part of this assessment, and mapping has been revised for this report. Vegetation assessment methods are described in more detail in Section 4.2.2.

4.2 Methods

4.2.1 Field survey dates and tasks

Vegetation surveys were conducted on the dates outlined in Table 4.1.

Table 4.1 Vegetation surveys

Dates	Surveys completed
27 to 29 August 2018	Floristic and vegetation integrity surveys (Umwelt)
31 October 2018	Floristic and vegetation integrity surveys (Umwelt)
22 and 23 January 2019	Floristic and vegetation integrity surveys (Umwelt)
27 March 2019	Floristic and vegetation integrity surveys (Umwelt)
2 and 4 April 2019	Floristic and vegetation integrity surveys (Umwelt)
27 and 28 November 2019	Floristic and vegetation integrity surveys (Umwelt)
24 and 25 March 2020	Floristic and vegetation integrity surveys (Umwelt)
11 November 2022	Vegetation mapping and rapid data point (RDP) surveys (EMM)
15 and 16 May 2023	Vegetation mapping and RDP surveys (EMM)

Dates	Surveys completed
22 to 24 November 2023	Vegetation integrity surveys (EMM)
29 to 30 January 2024	Upland swamp mapping (EMM)
19 to 22 February 2024	Vegetation mapping, during targeted flora surveys (EMM)
28 and 29 February 2024	Vegetation integrity surveys (EMM)

4.2.2 Vegetation mapping and stratification

i Survey effort by Umwelt

Initial vegetation surveys were undertaken by Umwelt between August 2018 and March 2020, and included mapping of PCTs and vegetation zones, rapid vegetation assessments and collection of plot data in accordance with the BAM (Umwelt 2020).

Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of PCTs
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

Each of the vegetation communities recorded were aligned with an equivalent PCT as detailed in the Vegetation Classification Database. For each vegetation community, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

Plot data was collected from the study area by Umwelt. At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure
- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1 to 5%) or estimated to the nearest 5% (5 to 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000, etc.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 3 of the BAM (DPIE 2020a). A total of five plots were undertaken within the subject land and used for this assessment. Not all plots completed by Umwelt were applied to this assessment. Plots that were outside of the study area, or that were situated on an ecotone of the updated vegetation mapping, were not used.

ii Survey effort by EMM

An initial field survey by EMM noted that the mapping of the Coastal Upland Swamps by Umwelt across the study area and broader site did not conform to the distribution of this community on the ground. This, combined with the introduction of the revised PCTs for eastern NSW, resulted in additional surveys being undertaken by EMM between November 2022 and May 2023 as part of the FFA (EMM 2023a).

To more reliably determine the potential extent of the Coastal Upland Swamps, a canopy height model (CHM) was developed using light detection and ranging (LiDAR) data. The potential extent of Coastal Upland Swamps was determined by mapping areas without any canopy where the extent exceeded 0.1 ha. This modelling was applied to the entirety of the site and can be seen in Figure 6.1.

The existing PCT mapping and mapping of potential Coastal Upland Swamps was used as the basis for vegetation validation and mapping surveys undertaken by EMM in 2023. During these surveys, PCT classification and linework were updated where required, and were informed by a combination of aerial photograph interpretation, ground truthing in the field, and potential Coastal Upland Swamps mapping derived from the CHM. Vegetation validation and mapping surveys for the FFA were undertaken across the study area on 15 and 16 May 2023.

Since the submission of the FFA, EMM has completed additional vegetation surveys (between November 2023 and February 2024), including the completion of additional vegetation integrity plots, refinement of swamp mapping through characterisation of soil hydrology, and application of the Plot to PCT Assignment Tool (NSW DCCEEW 2023b) (see Table 4.1). A total of seven plots were completed by EMM within the study area and used for this assessment. The majority of plot surveys were conducted prior to the final design of the proposed rezoning and biodiversity certification area. This was to inform the design and avoid and minimise biodiversity impacts where possible (see Section 6.1). For this reason, some plots are located outside of the subject land but are still situated within proximity of the subject land. Despite falling outside of the final design of the subject land, these are representative and have been used to inform the stratification of vegetation zones within the subject land.

Vegetation was mapped using the following techniques:

- meander surveys on foot to ground-truth PCT boundaries and collect rapid data (or vegetation validation) points
- delineation of boundaries of Coastal Upland Swamps by continuously tracking a traverse of swamp edges on foot, using a GPS-enabled tablet computer using ArcGIS Field Maps™
- surveys within mapped areas of Coastal Upland Swamps, using a probe to measure soil characteristics including depth, organic content, and moisture content (Figure 4.1)
- RDP assessments to collect information on dominant floristic composition and structure and other relevant observations such as landscape position and soil type
- review of BAM plot data collected by Umwelt and EMM to inform the vegetation mapping and stratification

- comparison of the dominant and characteristic species in each vegetation community with data in the BioNet Vegetation Classification database, to align with equivalent PCTs
- application of the Plot to PCT Assignment Tool (NSW DCCEEW 2023b) using BAM plot data collected by Umwelt and EMM, followed by analysis of centroid match results, to corroborate floristic results
- further characterisation of Coastal Upland Swamp areas based on a combination of centroid match results from the Plot to PCT Assignment Tool (floristics) and soil hydrology surveys
- desktop refinement of boundaries and PCT allocations, using BAM plot and RDP data, aerial imagery and potential Coastal Upland Swamps derived from the CHM.

Each of the vegetation communities was aligned with an equivalent PCT as detailed in the BioNet Vegetation Classification database. For each community, the dominant and characteristic species were compared to those listed in the potential PCTs identified for the site. This allocation was corroborated with the floristic results of the Plot to PCT Assignment Tool. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristics, vegetation structure, soil characteristics, landform, and distribution details.

Detailed vegetation mapping was completed within the study area boundary, although only the vegetation mapped within the subject land applies to the assessment in the BAM-C. Calculations of vegetation areas in the following sections refer to the subject land, unless otherwise stated.

PCTs were stratified into vegetation zones based on broad condition states. As a guide, the descriptions in Table 4.2 were used to identify vegetation zones for each PCT.

Table 4.2 Description of broad condition states

Condition class	Description
High	Vegetation is largely intact with all strata present and minimal disturbance.
Open	Vegetation is largely intact with minimal disturbance but is mostly lacking the canopy layer in a naturally occurring open woodland state.
Disturbed	Vegetation is somewhat intact, but with some disturbance such as presence of invasive species and evidence of regeneration from previous clearing activities.
Pines	Vegetation is disturbed with some strata missing or highly disturbed, due to the presence of invasive species including Cluster Pines (*Pinus pinaster*).

4.2.3 Identification of TECs

PCTs recorded in the study area and broader site were compared to TECs listed under the EPBC Act or BC Act. The following approach was used:

- a review of PCT and TEC associations based on the PCT-TEC associations data in the BioNet Vegetation Classification
- a review of TECs predicted to occur based on the BioNet Atlas of NSW Wildlife and the Commonwealth DCCEEW PMST
- a review of relevant NSW Scientific Committee Final Determinations or Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice
- a review of relevant scientific literature.

Two threatened ecological communities were identified as potentially occurring in the study area. An assessment of these PCTs against the TEC listings is provided in Section 4.3.5.

4.3 Results

4.3.1 Vegetation description

The study area contains a mix of shrubby woodland and heath vegetation communities, on a gentle southeast-facing slope. The study area is between 160 m and 230 m above sea level (ASL) in an area of Hawkesbury sandstone, with higher elevation areas containing occasional pieces of exposed ironstone. Soils vary from deeper sandy loam soils on the upper slopes, to shallow sandy soils on lower sandstone shelves, and sandy peat soils in swampy areas where the hydrology is impeded.

The higher elevation areas occur near Reeves Street, along the northern boundary of the site. In these areas, the canopy of the woodland community is taller and with a mix of eucalypt species including Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*), Silvertop Ash (*Eucalyptus sieberi*), Sydney Red Gum (*Angophora costata*) and stringybark species (*Eucalyptus agglomerata* and *Eucalyptus capitellata*). There is a dense and diverse shrub layer in these areas.

Further down the slope in areas with sandy soil, the canopy thins out into a more open woodland community with a canopy dominated by Scribbly Gum (*Eucalyptus haemastoma*) with the occasional Red Bloodwood (*Corymbia gummifera*) and Dwarf Apple (*Angophora hispida*). These areas have a lower and less dense canopy and lower shrub heights.

In low lying areas of the site and along drainage lines where hydrology is impeded, there are upland swamp heath communities, with little to no canopy cover and a dense ground cover of mesic species such as sedges and ferns.

The vegetation in the study area is generally in good condition with minimal disturbance evident. In the western corner of the site, near Reeves Street, the introduction of Cluster Pine (*Pinus pinaster*) has shaded out much of the mid- and understorey and disturbed the structure and composition of the native vegetation. The pines are spreading east into more intact native vegetation, in an area that currently maintains a predominantly native canopy and midstorey. In this area there is also evidence of previous clearing, with mature trees pushed over and the shell of a car within dense shrubs, suggesting it was once open enough to drive through. Further to the east, there is an area of disturbed vegetation associated with a drain that runs under Reeves Street to the south. The drain has affected the hydrology of the area such that there are tree ferns present and a high proportion of invasive species immediately downhill of the drain (Figure 4.1).

4.3.2 General site condition

The subject land is largely uncleared except for one walking track going from Reeves Street down towards Fountain Creek, and some historic rubbish dumping along Reeves Street. The vegetation on the subject land has generally been stable and is broadly unchanged since 2018 (Plate 4.1). The subject land has not experienced significant vegetation clearing or other anthropogenic disturbances. There are no observable drought impacts in the vegetation (such as canopy dieback) and the subject land has not been subjected to bushfire events in that period. There also have been no substantial changes in the surrounding land use and no material changes in access by the public.

a. August 2018

b. May 2019

c. February 2020

d. April 2024

Plate 4.1 **Aerial imagery of the subject land in August 2018, May 2019, February 2020 and April 2024 showing consistency in vegetation over time**

Imagery source: Google Earth Pro, version 7.3.6.9796: a. 20 August 2018, CNES/Airbus 2024; b. 29 May 2019, Maxar Technologies 2024; c. 18 February 2020, Maxar Technologies 2024; d. 1 April 2024, Airbus 2024.

4.3.3 Plant community types and vegetation zones

Four PCTs are identified within the subject land:

- PCT 3586 – Northern Sydney Scribbly Gum Woodland
- PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest
- PCT 3807 – Northern Sydney Heath-Mallee
- PCT 3924 – Sydney Coastal Upland Swamp Heath.

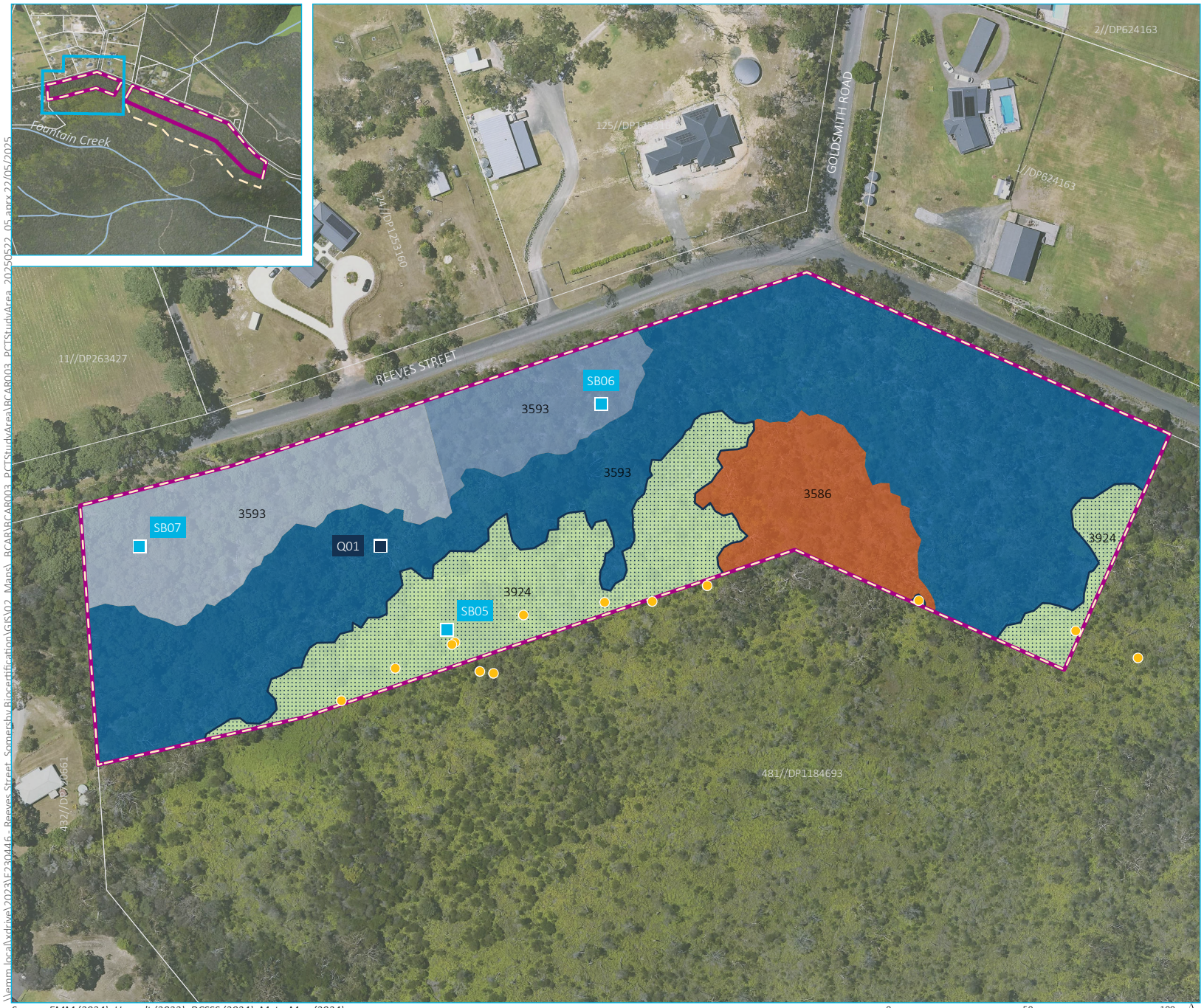
The vegetation mapping is broadly consistent with the mapping produced by Umwelt (2020), but PCTs have been converted to the revised PCTs for eastern NSW, and linework has been reviewed and refined based on the CHM and additional field surveys (see Section 4.2.2ii).

The PCTs outlined above were stratified into seven vegetation zones, aligning with the different condition classes present in the subject land (Table 4.3).

Table 4.3 PCTs and vegetation zones mapped in the subject land

PCT ID	PCT name	Condition	Extent within subject land (ha)
3586	Northern Sydney Scribbly Gum Woodland	High	2.09
		Open	0.27
3593	Sydney Coastal Sandstone Bloodwood Shrub Forest	High	7.68
		Disturbed	0.24
		Pines	0.77
3807	Northern Sydney Heath-Mallee	High	0.43
3924	Sydney Coastal Upland Swamp Heath	High	1.83

The PCTs identified are shown in Figure 4.1 and described in the following tables.



KEY

- Subject land
- Study area

BAM plot

- EMM
- Umwelt
- Soil probe location

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland

- High

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest

- High
- Disturbed
- Pines

PCT 3924 | Sydney Coastal Upland Swamp Heath

- High

Threatened ecological community

- Coastal Upland Swamps in the Sydney Basin Bioregion

Existing environment

- Watercourse/drainage line
- Cadastral boundary
- State forest

\\emm.local\xdrive\2023\EF230446 - Reeves Street, Somersby Biocertification\GIS\02_Maps_RCAR\RCAR003_PCTStudyArea\RCAR003_PCTStudyArea_20250522_05.aprx 22/05/2025

Source: EMM (2024); Umwelt (2023); DCSSS (2024); MetroMap (2024)

0 50 100 m

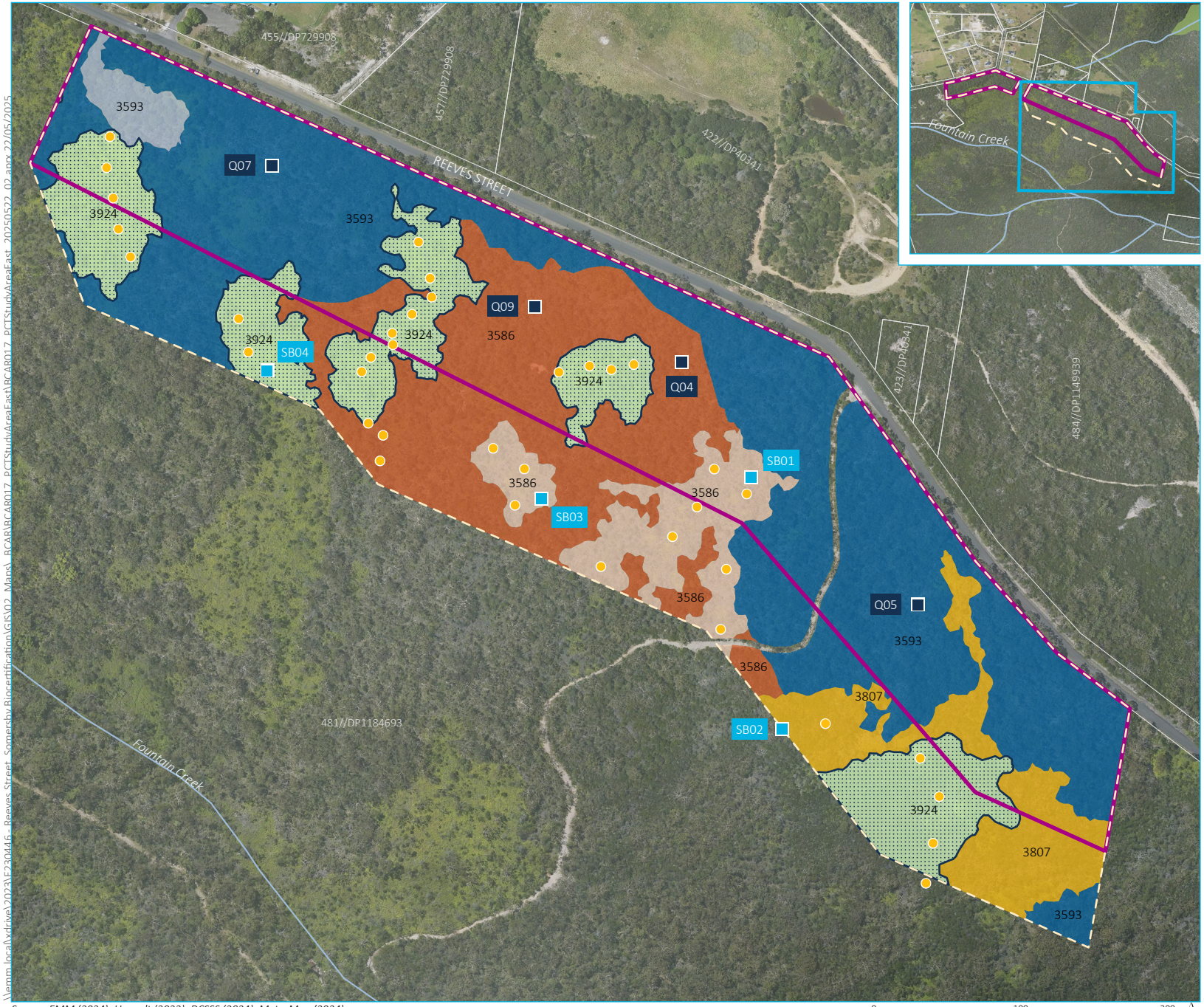
GDA2020 MGA Zone 56

N

Plant community types and vegetation zones within the study area

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 4.1a

EMM creating opportunities



KEY

- Subject land
- Study area

BAM plot

- EMM
- Umwelt
- Soil probe location

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland
- High
- Open

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest
- High
- Pines

PCT 3807 | Northern Sydney Heath-Mallee
- High

PCT 3924 | Sydney Coastal Upland Swamp Heath
- High

Threatened ecological community

- Coastal Upland Swamps in the Sydney Basin Bioregion

Existing environment

- Watercourse/drainage line
- Cadastral boundary
- State forest

Source: EMM (2024); Umwelt (2023); DCSSS (2024); MetroMap (2024)

0 100 200 m

GDA2020 MGA Zone 56

N

Plant community types and vegetation zones within the study area

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 4.1b

EMM creating opportunities

Table 4.4 PCT 3586 – Northern Sydney Scribbly Gum Woodland

Attribute	Description
PCT ID	3586
Common name	Northern Sydney Scribbly Gum Woodland
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Description	This community is a dry sclerophyll woodland found on Hawkesbury sandstone ridgetops of the Hornsby Plateau to the north of Sydney. The community occurs on lower sandstone shelves within the study area on shallow sandy soils. Sandstone is exposed in some areas. The canopy is stunted and low- to mid-density, comprising mostly Scribbly Gum (*Eucalyptus haemastoma*), but also containing Red Bloodwood (*Corymbia gummifera*) and Dwarf Apple (*Angophora hispida*). The mid-stratum contains a diverse and dense shrub layer, including Heath-leaved Banksia (*Banksia ericifolia*), Fern-leaved Banksia (*Banksia oblongifolia*) Old Man Banksia (*Banksia serrata*), Sweet Wattle (*Acacia suaveolens*), *Platysace linearifolia*, Conesticks (*Petrophile pulchella*), Slender Tea-tree (*Leptospermum trinervium*), Sunshine Wattle (*Acacia terminalis*) and multiple other species from the genera *Pimelea*, *Boronia*, *Darwinia* and *Persoonia*. The ground layer contains a mix of grasses, forbs and sedges, including Lesser Flannel Flower (*Actinotus minor*), Wiry Panic (*Entolasia stricta*), Curly Wig (*Caustis flexuosa*), *Bossiaea scolopendria* and *Dampiera stricta*.
Location	PCT 3586 occurs on lower areas of the study area with shallow sandy soils (Figure 4.1). In areas with more shallow and dry soils, it is present in a heath-mallee formation and in some places is missing a canopy layer altogether. In these areas it appears to be present as an intergrade between taller Red Bloodwood (*Corymbia gummifera*) woodland and upland swamps.
Extent within subject land	Total: 2.36 ha Vegetation zones: • High: 2.09 ha • Open: 0.27 ha
Survey effort	Vegetation zones: • High: Q04, Q09 • Open: SB01, SB03
Condition description	This community is relatively undisturbed throughout the study area, with high floristic diversity and little to no weed incursions. The community has been mapped in two naturally occurring condition states, High and Open. In the areas of High condition, all vegetation strata are intact, and the community is present as a woodland with a tree canopy consisting of predominantly *Eucalyptus haemastoma* as well as a diverse shrub layer. In the areas mapped as Open condition, the tree canopy is largely absent but the ground and shrub layers are intact. This is a natural condition state occurring in lower lying areas of the site, on very shallow and dry sandy soils.

Attribute	Description
Justification of evidence and species used to identify the PCT	This community fits the description for PCT 3586 in the BioNet Vegetation Classification database, being a mid-high sclerophyll woodland with a diverse heathy shrub layer. The community contains a high proportion of the characteristic species listed in the PCT description and is located on a sandstone ridgetop of the Hornsby Plateau as per the description. The canopy layer is dominated by Scribbly Gum (*Eucalyptus haemastoma*) with the occasional Red Bloodwood (*Corymbia gummifera*). The canopy occurs at a lower density and height than the taller shrubby woodland further up the slopes in the study area (PCT 3593). Characteristic species such as Dwarf Apple (*Angophora hispida*) were recorded within this community and not in adjacent areas. The midstorey contains many of the characteristic species listed in BioNet, such as Heath-leaved Banksia (*Banksia ericifolia*), Fern-leaved Banksia (*Banksia oblongifolia*), Old Man Banksia (*Banksia serrata*), Slender Tea-tree (*Leptospermum trinervium*), and Conesticks (*Petrophile pulchella*). Analysis of vegetation integrity data using the Plot to PCT Assignment Tool (NSW DCCEEW 2023b) showed that the four plots completed in this PCT are well floristically matched to PCT 3586. PCT 3586 was the closest match (based on centroid data) for three out of the four plots, and all four plots were under the 0.695 threshold value. This community was mapped as distinct from the adjacent PCT 3593 based on its lower and more open canopy, its less diverse canopy species composition containing largely Scribbly Gum (*Eucalyptus haemastoma*), and its position at lower elevations of the site on shallow sandy soil. The 'Open' vegetation zone in PCT 3586 was previously mapped as PCT 3924 (Sydney Coastal Upland Swamp Heath) based on the lack of canopy layer. However, further field surveys revealed that the soils in this area were dry, sandy and very shallow (0.05-0.15m), whereas soils in PCT 3924 were consistently moist, deeper, and contained more organic matter. Analysis of centroid data from the Plot to PCT Assignment Tool (NSW DCCEEW 2023b) aligned the floristics in the two 'Open' plots strongly with PCT 3586.
Status	Not a TEC. This PCT is not associated with any TECs.
Estimate of percent cleared value of PCT	14.99%

Photograph 4.1 PCT 3586: High condition

Photograph 4.2 PCT 3586: Open condition

Table 4.5 PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest

Attribute	Description
PCT ID	3593
Common name	Sydney Coastal Sandstone Bloodwood Shrub Forest
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Description	This community is a tall, heathy dry sclerophyll woodland found on coastal plateaus around Sydney. It is known to occur on exposed residual ironstone and Hawkesbury sandstone crests and slopes. The canopy contains a mix of Eucalypt species, dominated by Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*) and Silvertop Ash (*Eucalyptus sieberi*), as well as Blue-leaved Stringybark species (*E. agglomerata*) and Sydney Red Gum (*Angophora costata*). The mid-stratum contains a mix of small trees such as Old Man Banksia (*Banksia serrata*) and Slender Tea-tree (*Leptospermum trinervium*) as well as a layer of smaller shrubs including Sweet Wattle (*Acacia suaveolens*), Broad-leaved Geebung (*Persoonia levis*), Needlebush (*Hakea sericea*), Heath-leaved Banksia (*Banksia ericifolia*), Tantoon (*Leptospermum polygalifolium*) and multiple other species from the genera *Isopogon*, *Pimelea*, *Petrophile*, and *Epacris*. The ground layer contains a sparse mix of grasses and forbs, including Lesser Flannel Flower (*Actinotus minor*), Screw fern (*Lindsaea linearis*), *Lepyrodia scariosa* and *Baloskion* sp.
Location	PCT 3593 is found on more elevated sections of the study area with deeper sandy soils, along the length of Reeves Street (see Figure 4.1).
Extent within study area	Total: 8.70 ha Vegetation zones: • High: 7.68 • Disturbed: 0.24 • Pines: 0.77
Survey effort	Vegetation zones: • High: Q01, Q05, Q07 • Disturbed: SB06 • Pines: SB07

Attribute	Description
Condition description	This PCT occurs in three condition states across the study area (see Figure 4.1). The majority of the PCT is in good condition, with low disturbance levels, and every stratum intact. These areas have been mapped as High condition. In the western corner of the study area, adjacent to Reeves Street, there is an area that contains introduced Cluster Pines (*Pinus pinaster*). The disturbance from this species is greatest in the western corner of the site where the pines are larger and more dominant. In the far western section of the site the upper canopy is dominated by large pines, as well as a layer of Black She-Oak (*Allocasuarina littoralis*) in the lower canopy and mid storey. Characteristic species such as Scribbly Gum (*Eucalyptus haemastoma*), Red Bloodwood (*Corymbia gummifera*) and Silvertop Ash (*Eucalyptus sieberi*) are also present. The diversity of the midstorey and ground layer are reduced due to shading effects, but native species such as Tantoon (*Leptospermum polygalifolium*), Sweet Pittosporum (*Pittosporum undulatum*), Conesticks (*Petrophile pulchella*), Heath-leaved Banksia (*Banksia ericifolia*), and Narrow-leaved Geebung (*Persoonia linearis*) are present. The ground layer is largely covered in pine needles, although some native species are present. This area has been mapped as a Pines vegetation zone. Also mapped in the Pines condition state is an area adjacent to a drain running under Reeves Street, which has introduced invasive species and altered the hydrology in the area. Invasive species including Pampas Grass (*Cortaderia* sp.), Lantana (*Lantana camara*) and Crofton Weed (*Ageratina adenophora*) are prevalent, and the canopy layer is reduced, potentially due to the change in hydrology. Although the area does not contain invasive pine species, it has been significantly disturbed by dominant invasive species so is considered to be in a similar relative condition. Between the area dominated by pines in the western corner, and more intact vegetation to the east, is an area mapped in a disturbed condition. This area contains some Cluster Pine (*Pinus pianster*) in the canopy layer but at a much lower density than the Pines condition area, and the trees are generally of a smaller size. There is evidence of past clearing disturbance with the canopy of *Eucalyptus* spp. generally lacking and mature trees pushed over, and the shell of a car suggesting the vegetation was previously clear enough to drive through. The area has a more intact midstorey, with a high density of native shrubs dominated by Tantoon (*Leptospermum polygalifolium*).
Justification of evidence and species used to identify the PCT	The areas of PCT 3593 within the study area are a good fit for the community described in the BioNet Vegetation Classification database, being a tall heathy sclerophyll open forest, located on a coastal plateau of Hawkesbury sandstone with exposed residual ironstone present. The PCT is known to occur on the margins of the Somersby Plateau. The canopy contains all the key species mentioned in BioNet Vegetation Classification database, comprising a high proportion of Red Bloodwood (*Corymbia gummifera*), as well as a mix of Scribbly Gum (*Eucalyptus haemastoma*), stringybarks, Sydney Red Gum (*Angophora costata*) and Silvertop Ash (*Eucalyptus sieberi*). The community has a diverse mid storey, again including all the key species described in BioNet, such as Old Man Banksia (*Banksia serrata*), Slender Tea-tree (*Leptospermum trinervium*), Mountain Devil (*Lambertia formosa*) and Broad-leaved Geebung (*Persoonia levis*). Analysis of vegetation integrity data using the Plot to PCT Assignment Tool (NSW DCCEEW 2023b) showed that the three plots completed in the High condition zones of this PCT are well floristically matched to PCT 3593. PCT 3586 was the closest match (based on centroid data) for plots Q01 and Q05, the second match for plot Q07 (still under the 0.695 threshold value). The Plot to PCT tool was less conclusive for the plots in the disturbed and Pines condition areas with very few appropriate matches under the 0.695 threshold value (unsurprising given that floristic assemblage is disrupted by exotic species). However, PCT 3593 was the second and third match for each plot. These areas have been mapped as PCT 3593 based on a range of factors including proximity to areas of intact PCT 3593 and obvious disturbances. This community was mapped as distinct from the adjacent PCT 3586 based on its taller and denser canopy, more diverse canopy species composition containing a higher proportion of Red Bloodwood (*Corymbia gummifera*), and its position at higher elevations of the site with deeper soil.
Status	Not a TEC. The BioNet Vegetation Classification database indicates that PCT 3593 may be associated with Duffy's Forest Ecological Community in the Sydney Basin Bioregion, listed as endangered under the BC Act. However, occurrences of PCT 3593 mapped in the study area are not considered to form part of the TEC. A detailed discussion is provided in Section 4.3.5ii.
Estimate of percent cleared value of PCT	19.25%

Photograph 4.3 PCT 3593: High condition

Photograph 4.4 PCT 3593: Disturbed condition

Photograph 4.5 PCT 3593: Pines condition

Table 4.6 PCT 3807 – North Sydney Heath Mallee

Attribute	Description
PCT ID	3807
Common name	North Sydney Heath Mallee
Vegetation formation	Heathlands
Vegetation class	Sydney Coastal Heaths
Description	This community can be a tall heathland or closed heathland, mallee shrubland or low sclerophyll woodland with a dense heathy mid stratum, known from across the Hornsby Plateau. Within the study area, the community is a tall, closed heath community dominated by Heath-leaved Banksia (*Banksia ericifolia*). The community is known from exposed skeletal sandstone soils along ridges, outcrops and level areas of exposed rock (sandstone pavements). Within the study area, it has been mapped on a low-lying sandstone pavement with shallow sandy soils. The community is mapped adjacent to areas of upland swamp, but the soils are too thin and are not wet enough to support a more mesic swamp community. There is no canopy layer except for the occasional emergent Scribbly Gum (*Eucalyptus haemastoma*) and Red Bloodwood (*Corymbia gummifera*). In the mid storey, Heath-leaved Banksia (*Banksia ericifolia*) is dominant and extremely dense, leading to a decrease in species complexity in lower layers.
Location	PCT 3807 is mapped in lower lying areas of the study area with sandy soils, adjacent to swamps but without the appropriate soil hydrology (Figure 4.1).
Extent within study area	Total: 0.43 ha Vegetation zones: • High: 0.43 ha
Survey effort	Vegetation zones: • High: SB02
Condition description	The extent of this community within the study area is relatively undisturbed and has only been mapped as one condition state – High. There is no evidence of disturbance and little to no weed incursions.
Justification of evidence and species used to identify the PCT	This community fits the description for PCT 3807 in the BioNet Vegetation Classification database, being a tall, closed heathland with emergent eucalypts on the Hornsby Plateau. It is known to grade into both PCT 3586 and PCT 3593 (both mapped on site) with changes in soil and hydrology. The Plot to PCT Tool was inconclusive for this vegetation zone, with the top ten PCT matches all under the 0.695 threshold for centroid distance values. PCT 3807 was the fourth match. This community was mapped as distinct from the adjacent PCT 3593 based on the changes in vegetation strata. PCT 3807 has no dominant eucalypt canopy, and an extremely dense layer of Heath-leaved Banksia (*Banksia ericifolia*) (see Photograph 4.6). As outlined above, this community has been differentiated from PCT 3924 due to its occurrence on drier, shallow, sandy soils in areas where hydrological conditions are not conducive to the formation of Coastal Upland Swamps. These areas generally lack the sedges and rushes seen in PCT 3924. The area of 3807 mapped on the site surrounds an area of PCT 3924, where soils were consistently moist and deeper than the surrounding PCT 3807.
Status	Not a TEC. This PCT is not associated with any TECs.
Estimate of percent cleared value of PCT	5.1%

Photograph 4.6 PCT 3807: High condition

Table 4.7 PCT 3924 – Sydney Coastal Upland Swamp Heath

Attribute	Description
PCT ID	3924
Common name	Sydney Coastal Upland Swamp Heath
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Heath Swamps
Description	This community is a tall heathland or closed heathland with a dense cover of sedges and little to no eucalypt emergents. It occurs on lower lying areas of the site with damp, sandy peat soils that can support mesic species. In areas of this PCT within the study area the canopy layer is largely absent, with only the occasional emergent Eucalypt. In some areas, the midstorey is dominated by Heath-leaved Banksia (*Banksia ericifolia*) with other midstorey species including Tantoon (*Leptospermum polygalifolium*), Mountain Devil (*Lambertia formosa*), Conesticks (*Petrophile pulchella*) and Needlebush (*Hakea teretifolia*). The ground layer contains a mix of ferns, sedges and rushes, such as Pouched Coral Fern (*Gleichenia dicarpa*), Spreading Rope-rush (*Empodisma minus*), *Lepyrodia scariosa*, Screw Fern (*Lindsaea linearis*) and *Cassytha glabella*.
Location	PCT 3924 is found in the low-lying areas of the study area with sandy peat soils (Figure 4.1). The PCT occurs where hydrology has been impeded, leading to damp soils that can support the characteristic species.
Extent within study area	Total: 1.83 ha Vegetation zones: • High 1.83 ha
Survey effort	Vegetation zones: • High: SB04, SB05
Condition description	The extent of this community within the study area is relatively undisturbed and has only been mapped as one condition state – High. There is no evidence of disturbance and little to no weed incursions. There is some variation in the species composition of this PCT within the study area and broader site, likely driven by soil moisture and depth. In some areas, on shallower soils and lower moisture levels, this PCT occurs as a mosaic with surrounding woodlands. In these areas boundaries are difficult to differentiate, likely with a dynamic boundary depending on prevailing climatic conditions. In other areas, with deeper soils and higher moisture content, the boundaries between this PCT and surrounding woodlands is stark and clear.

Attribute	Description
Justification of evidence and species used to identify the PCT	This community was identified based on the structure of vegetation (little to no canopy); the presence of key mid- and understorey species such as Heath-leaved Banksia (*Banksia ericifolia*), Needlebush (*Hakea teretifolia*) and Spreading Rope-rush (*Empodisma minus*); position within the landscape; hydrology, and soil texture, depth and moisture content. This community fits the description for PCT 3924 in the BioNet Vegetation Classification database, being a heathland community occurring on impeded sandy peat soils within the study area, with a dense groundcover of sedges and ferns. The process for mapping this community included the application of a canopy height model to delineate areas of the site without a substantial canopy layer. This was ground-truthed during initial field mapping, where the canopy edge was mapped on foot. Additional surveys were undertaken to measure soil characteristics in swamp areas, including soil depth, organic content, and moisture content. PCT 3924 was only mapped in areas where hydrology was impeded and the soil was reliably moist. The Plot to PCT Tool was inconclusive for this vegetation zone, with only one of the top ten PCT matches in one of the plots under the 0.695 threshold for centroid distance values. The top match based on floristics was PCT 3923 (although it was only above the threshold in one plot), which is a community that occurs along creek lines, which does not match the topographic position of the study area. The BioNet Vegetation Classification database states that PCT 3924 and 3923 have floristic and spatial overlap, but can be distinguished by creek line topographic position. Most other PCTs listed in the results of the Plot to PCT Tool do not occur in the correct IBRA sub-bioregion so were disregarded. PCT 3924 was included in the results of one of the plots, as the second-best match of the PCTs that occur within the sub-bioregion of the site. Areas currently mapped as PCT 3586 (Northern Sydney Scribbly Gum Woodland) in the Open condition state were previously included in the mapping for PCT 3924, based on the lack of canopy layer. Additional field data showed that the soils in these areas were dry, sandy and very shallow (0.05-0.15m), whereas soils in PCT 3924 were consistently moist, deeper, and contained more organic matter. Additionally, the plot data collected in these areas aligned the floristics strongly with PCT 3586 based on the results of the Plot to PCT Assignment Tool. Areas of PCT 3924 were distinguished from surrounding areas of PCT 3807 (North Sydney Heath Mallee) based on floristics and soil characteristics. PCT 3924 has been mapped in areas where soil was consistently moist and deeper than surrounding areas of PCT 3807, and in areas that contain the characteristic sedges and rushes that were lacking in surrounding areas. PCT 3896 was also considered in the delineation of this community due to the high cover of *Gleichenia dicarpa* in some areas. However, this community does not occur in the IBRA sub-bioregion of the site and is known from further south in the Sydney Basin. It is replaced by PCT 3924 on impeded sandy peats on Hawkesbury Sandstone, which fits the location of the study area.
Status	Associated with Coastal Upland Swamp in the Sydney Basin Bioregion, listed as endangered under the BC Act and the EPBC Act. Vegetation in the study area is consistent with the TEC (see Section 4.3.5i).
Estimate of percent cleared value of PCT	2.95%

Photograph 4.7 PCT 3924: High condition

Photograph 4.8 PCT 3924: boundary of swamp and woodland

4.3.4 Exotic vegetation

While no areas have been mapped as exotic vegetation, some areas of the site contain exotic species. The vegetation zones adjacent to Reeves Street contain mature Cluster Pine (*Pinus pinaster*) as part of the canopy layer. A number of weeds recorded within the study area are classed as High Threat Weed species under the BAM (DPE 2022a), including:

- Cluster Pine (*Pinus pinaster*)
- Crofton Weed (*Ageratina adenophora*)
- Pampas Grass (*Cortaderia* sp.)
- Blackberry (*Rubus fruticosus* species aggregate)
- Whiskey Grass (*Andropogon virginicus*).

4.3.5 Threatened ecological communities

Two TECs are associated with the PCTs identified within the subject land.

PCT 3924 is associated with the Coastal Upland Swamp in the Sydney Basin Bioregion (Coastal Upland Swamp EEC). This community is listed as endangered under the BC Act and the EPBC Act. An assessment of PCT 3924 against the gazetted descriptions under the BC Act and EPBC Act is provided in Section 4.3.5i. This assessment determined that the areas of PCT 3924 identified in the study area are consistent with the Coastal Upland Swamp EEC (Table 4.8).

PCT 3593 is associated with the Duffy's Forest Ecological Community in the Sydney Basin Bioregion (Duffy's Forest EEC). This TEC is listed as Endangered under the BC Act only. An assessment of PCT 3593 against the BC Act Final Determination is provided in Section 4.3.5ii (DPE 2021b). This assessment concluded that the vegetation in PCT 3593 within the study area is not consistent with Duffy's Forest EEC.

Table 4.8 TECs present within the subject land

TEC name	BC Act status	EPBC Act status	Associated vegetation zones within the subject land	Area within subject land (ha)
Coastal Upland Swamp in the Sydney Basin Bioregion	Endangered	Endangered	3924_High	1.83

i Coastal Upland Swamp in the Sydney Basin Bioregion

PCT 3924 is associated with Coastal Upland Swamp in the Sydney Basin Bioregion (Coastal Upland Swamp), listed as endangered under both the BC Act and the EPBC Act. The criteria for the BC Act listing and the EPBC Act listing are very similar and have been combined and analysed in Table 4.9 (DPE 2021a, DoE 2014). This analysis determined that all areas mapped as PCT 3924 are representative of the Coastal Upland Swamp TEC as listed under both the BC Act and EPBC Act.

Table 4.9 Criteria for determining presence of Coastal Upland Swamp in the Sydney Basin Bioregion

Criteria from Conservation advice	Discussion
Located on Somersby-Hornsby Plateau in the north to the Woronora plateau and Robertson in the south.	The subject land is located on the Somersby Plateau.
Occurs on sandstone plateaus, in headwater valleys of streams on a sandstone bench.	The subject land consists of a sandstone plateau with the Coastal Upland Swamps mapped on a series of low relief sandstone benches.
Occurs at 200 to 450 m ASL.	The subject land is located at 230 to 180 m ASL.
Areas of impeded hydrology and evidence of waterlogged soil.	Areas mapped as PCT 3924 occur on low relief sandstone benches where flow of water is likely to be impeded by this low relief. This has led to the build-up of organic material in the soil, increasing impediment of drainage. Soil surveys were conducted by EMM as part of vegetation mapping, using a probe to determine the depth, composition and moisture content of the soil. PCT 3924 was mapped in areas with damp soil (Figure 4.1).
Mostly treeless, with the occasional scattered individual or isolated clumps of eucalypts.	Vegetation in the study area is treeless with only occasional emergent Eucalypts.
An indicative list of vascular plant species characteristic of the Coastal Upland Swamps is given in Table 1 of the Conservation Advice (DoE 2014).	At least six characteristic species were recorded in the plots completed by EMM in mapped areas of Coastal Upland Swamps. Key species within the swamp are absent/uncommon in the surrounding landscape (e.g. *Gleichenia* sp. and Spreading Rope-rush (*Empodisma minus*)).

ii Duffy's Forest Ecological Community in the Sydney Basin Bioregion

PCT 3593 is associated with Duffy's Forest Ecological Community in the Sydney Basin Bioregion (Duffy's Forest EEC), listed as endangered under the BC Act. The vegetation community present in the study area has been assessed according to the criteria outlined in the Final Determination for Duffy's Forest EEC (DPE 2021b), as outlined in Table 4.10.

Whilst evaluation against the Final Determination suggests some affinity of the occurrence of PCT 3593 in the study area with Duffy's Forest EEC, further assessment using fidelity-type analyses was undertaken and the details are provided following Table 4.10.

Table 4.10 Criteria for determining presence of Duffy's Forest EEC

Criteria from final determination	Discussion
Occurs on ridgetops, plateaus, upper slopes and occasionally mid slopes on Hawkesbury sandstone geology, typically in association with laterite soils and soils derived from shale and laminite lenses.	The study area is located in Hawkesbury sandstone. There is no evidence of laminite or shale lens within the study area. Some areas at the highest points of the study area contain occasional ironstone nodules and lateritic soils occur more broadly across the site, outside the subject land.
Structural form predominantly of open-forest to woodland.	The vegetation within the study area occurs as an open-forest or woodland.

Criteria from final determination	Discussion
Reported from the Warringah, Pittwater, Ku-ring-gai, Hornsby and Manly LGAs, although it may occur elsewhere in the Sydney Basin Bioregion.	The study area is within the Central Coast Local Government Area, not located within the listed LGAs. The study area is not included in the extent of Duffy's Forest EEC mapped by NPWS (2004). Although the Final Determination does not formally designate a geographic limit on the distribution of Duffy's Forest EEC within the Sydney Basin Bioregion, it is clear that the described community is not typically known to occur on the Central Coast.
Characteristic assemblage of vascular plants.	Thirty-five of the 73 species listed in the determination were recorded in areas of PCT 3593 in the study area. CPHR requested that *Eucalyptus agglomerata* and *Eucalyptus capitellata* be carefully identified on the site, as *E. capitellata* is characteristic of Duffy's Forest EEC. *Eucalyptus capitellata* was recorded in plot SB02 only, within PCT 3807, which is not an area that would be considered part of the TEC. *Eucalyptus agglomerata* was identified elsewhere in woodland areas, in plots Q01, Q04, Q07 and SB07.
Smith & Smith (2000) give a list of diagnostic plant species and describe how the community can be distinguished from surrounding ecological communities.	A diagnostic test undertaken in line with Smith & Smith (2000) suggests the vegetation in the study area is closer to Sandstone Ridgetop Woodland than to Duffy's Forest EEC (see details in Section 4.3.5iia below). An additional diagnostic test was completed using Tozer *et al.* (2010) which describes Duffy's Forest EEC as part of the broader map unit Sydney Shale-Ironstone Cap Forest. Based on plot data, the test did not suggest that Sydney Shale-Ironstone Cap Forest was present in the study area (see details in Section 4.3.5iib below).

a Diagnostic test for Duffy's Forest EEC from Smith & Smith (2000)

An analysis of species recorded across PCT 3593 during plot surveys was undertaken using the Duffy's Forest Index method described in Smith and Smith (2000). The method uses floristic assemblage to distinguish between three similar ecological communities – Duffy's Forest, Sydney Sandstone Ridgetop Woodland (SSRW) and Sydney Sandstone Gully Forest (SSGF). Twenty positive diagnostic species and twenty negative diagnostic species have been identified for each community (Smith & Smith 2000), and their presence or absence at a site is used to calculate an index for each community. A higher index value for a community indicates that the vegetation at the site most closely resembles that community (Smith and Smith 2000, p. 16)

Sydney Sandstone Ridgetop Woodland and Sydney Sandstone Gully Forest are not TECs. Sandstone Gully Forest can be excluded from further consideration for this site as PCT 3593 within the subject land does not occur in a gully position. However, Duffy's Forest and Sandstone Ridgetop Woodland both occur on ridgetop positions, similar to the site, and therefore have been compared for the analysis.

A Duffy's Forest Index (DFI) was calculated for Duffy's Forest EEC and Sydney Sandstone Ridgetop Woodland, using the equation from Smith and Smith (2000), which is replicated below.

$$DFI = \frac{100(x + (20 - y))}{40}$$

Notes: x = number of positive diagnostic species

y = number of negative diagnostic species

The assessment produced an index of 45 for Duffy's forest EEC, and 55 for Sydney Sandstone Ridgetop Woodland (Table 4.11).

Table 4.11 Diagnostic assessment for Duffy's Forest EEC (in accordance with Smith and Smith 2000)

	Duffy's Forest EEC	Sydney Sandstone Ridgetop Woodland
Positive species	3	2
Negative species	5	4
Duffy's Forest Index	45	55

Although a relatively small number of diagnostic species are present at the site, this test suggests that the candidate vegetation in the study area is closer to Sydney Sandstone Ridgetop Woodland than to Duffy's Forest EEC.

In their assessment Smith and Smith (2000) also looked at vegetation in Somersby. They found that the vegetation they assessed in Somersby "has closer affinity with Sydney Sandstone Ridgetop Woodland than with Duffy's Forest" (Smith and Smith 2000, p. 35).

b Diagnostic test for Duffy's Forest EEC from Tozer et al (2010)

Tozer et al (2010) describe Duffy's Forest EEC as part of their broader map unit Sydney Shale-Ironstone Cap Forest and they define positive diagnostic species for identifying the map unit based on vegetation plot data. A plot located in Sydney Shale-Ironstone Cap Forest is expected to contain at least 26 of the listed positive diagnostic species, provided the total number of native species in the plot is 43 or greater (Tozer et al 2010, p. 535). If the test plot does not contain the minimum number of species specified for the map unit, the test cannot be applied.

The plot data collected in PCT 3593 within the study area has been assessed using this method, with the results outlined in Table 4.12.

Table 4.12 Diagnostic test from Tozer et al (2010) for Sydney Shale-Ironstone Cap Forest (DSF p143)

Plot	Condition	Total no. of species in plot	No. positive diagnostic species	Vegetation part of map unit DSF p143?
Q01	3593_High	48	24	No
Q05	3593_High	40	27	NA (test cannot be applied)
Q07	3593_High	33	21	NA (test cannot be applied)
SB06	3593_Disturbed	54	17	No
SB07	3593_Pines	67	25	No

In all plots where the test is able to be applied (Q01, SB06, SB07), the floristic data does not indicate that the vegetation comprises the Sydney Shale-Ironstone Cap Forest map unit (and therefore does not comprise Duffy's Forest EEC).

c Conclusion

Although the vegetation within the study area represents some characteristics of Duffy's Forest EEC, including some characteristic flora species and marginal geology on the upper slope of the site, it is considered unlikely that the TEC is present at the site for the following reasons:

- vegetation is more characteristic of sandstone ridgetop woodland than Duffy's Forest EEC (Smith and Smith 2000).
- vegetation does not comprise Sydney Shale-Ironstone Cap Forest (which includes Duffy's Forest EEC) (Tozer et al 2010).
- soils in the subject land do not show any evidence of shale or laminate lenses.
- laterites do occur more broadly across the site, and Duffy's Forest EEC may occur elsewhere.
- although the Final Determination does not formally designate a geographic limit on the distribution of Duffy's Forest EEC, the described community is not typically known to occur on the Central Coast LGA and the area was not included in the extent of Duffy's Forest EEC mapped by NPWS (2004).

5 Threatened species

5.1 Threatened species assessment process

Surveys for threatened species were completed within the study area, which was previously being considered as the biocertification area. The data collected in the study area then informed an iterative design process to define the current subject land.

The vegetation and habitat is continuous between the study area and subject land, so the data collected in the study area is considered representative of that in the subject land. Although survey effort was based on the study area, only the data and records from the subject land were applied to the assessment in the BAM-C.

The presence of threatened species within the subject land was assessed according to Section 5.2 of the BAM (DPIE 2020a). The following steps were undertaken:

- Step 1: Identify which threatened species need to be considered for assessment. This was completed based on review of the following data sources:
    - a list of species associated with the PCTs mapped within the study area formed by generating a vegetation associations report in the Threatened Biodiversity Data Collection (TBDC), specific to the IBRA subregion where the study area is located; this step was completed in lieu of setting up a case in the BAM-C
    - threatened species that have been previously recorded in the locality
    - species predicted to occur by the EPBC Act Protected Matters Search Tool (PMST).
- Step 2: Assess geographic and habitat constraints listed for each species in the TBDC based on field assessment of habitat constraints present and eliminate species:
    - where the study area does not match the geographic constraints
    - for which the habitat constraints do not occur in the study area
    - that are vagrant in the IBRA subregion.

  This step results in a list of ecosystem credit species to be assessed for impacts, referred to as 'predicted species' (Table 5.1) and a list of candidate species credit species (Table 5.3) that require further assessment under Steps 3 to 6 below.
- Step 3: Further assess habitat for candidate species credit species. After a field assessment of the habitat present in the study area, the probability of each threatened species occurring on the study area is assessed, based on the quality of habitat and the presence of microhabitats required by each species. Species without suitable microhabitat or for which habitat is degraded do not require further assessment. The Step 3 assessments are outlined in Table 5.3.
- Step 4: Determine the presence of candidate species through targeted surveys, assumption of presence, or expert reports. Survey methods are summarised in Section 5.4.3. Targeted surveys were completed by Umwelt in 2018, 2019 and 2020, based on a previous iteration of the study area. Further surveys have been completed by EMM in 2023 and 2024 as part of this assessment.
- Steps 5: Determine the area or count and locations of suitable habitat (defining a species polygon). Species polygons are defined in Section 5.4.5.

- Step 6: Defining species polygons for species present in the subject land and determining habitat condition within species polygons.

5.2 Habitat description

The study area contains a range of habitats, from shrubby woodland to areas of heath and swamp, which are expected to support a range of threatened and non-threatened species.

In the woodland areas of the study area, several tree hollows have been recorded, which provide potential breeding and roosting habitat for arboreal mammals, owl species, and cockatoos. The forested areas provide habitat for a range of woodland birds, and there is fallen timber throughout the study area, providing cover for ground-dwelling mammals and potentially reptiles.

The shrub layer contains an abundance of flowering species that provide foraging habitat for small mammals and birds, as well as shelter and roosting habitat.

The low-lying areas of the site support areas of upland swamps with a dense ground layer and emergent shrubs. This swamp habitat provides potential habitat for invertebrates such as the Giant Dragonfly (*Petalura gigantea*), mammals such as the Long-nosed Potoroo (*Potorous tridactylus*) and the Eastern Pygmy-possum (*Cercartetus nanus*), as well as a range of amphibians, bird species, and mesic flora species such as sedges and ferns.

The subject land sits on Hawkesbury Sandstone, with some pieces of exposed ironstone in the areas of higher elevation. Soils range from deeper sandy loam soils on the upper slopes, to shallow sandy soils on lower sandstone shelves, and sandy peat soils in swampy areas where the hydrology is impeded. There is no evidence of laminite or shale lenses within the study area, and no overall shale influence or transition habitat, with the edge of the Wianamatta Shale Group approximately 30km to the south.

5.3 Ecosystem credit species

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (DPIE 2020a), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the study area is provided in Table 5.1. Three species have been excluded for this assessment based on the absence of habitat constraints – these include the Australasian Bittern, Black Bittern and Australian Painted Snipe (Table 5.2).

Some threatened species are listed as both ecosystem credit species and species credit species. In these cases, those species will also be addressed in Section 5.4

Table 5.1 Predicted ecosystem credit species within the study area

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Moderate	-	-
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	Moderate	-	-
Calyptorhynchus lathami lathami	Glossy Black-Cockatoo (Foraging)	High	Presence of Allocasuarina and casuarina species.	The habitat constraint is present with Black She-oak (*Allocasuarina littoralis*) present in PCT 3586, 3593 and 3807.
Circus assimilis	Spotted Harrier	Moderate	-	-

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	High	-	-
Daphoenositta chrysoptera	Varied Sittella	Moderate	-	-
Dasyurus maculatus	Spotted-tailed Quoll	High	-	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	High	-	-
Glossopsitta pusilla	Little Lorikeet	High	-	-
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	High	Waterbodies: within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines.	The study area is approximately 2.5 km from upper reaches of Brisbane Waters. Fountain Creek is located within the broader site but is only a first order stream and does not provide suitable breeding habitat for this species. The study area is less than 0.5 km away from the Lower and Upper Gosford Railway dams, which occur on Fountain Creek. On that basis this species has been conservatively assessed for ecosystem credits.
Hieraaetus morphnoides	Little Eagle (Foraging)	Moderate	-	-
Hirundapus caudacutus	White-throated Needletail	High	-	-
Hoplocephalus bungaroides	Broad-headed Snake (Foraging)	High	-	-
Lathamus discolor	Swift Parrot (Foraging)	Moderate	-	-
Lophoictinia isura	Square-tailed Kite (Foraging)	Moderate	-	-
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Moderate	-	-
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	High	-	-
Miniopterus australis	Little Bent-winged Bat (Foraging)	High	-	-
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	High	-	-
Neophema pulchella	Turquoise Parrot	High	-	-
Pandion cristatus	Eastern Osprey (Foraging)	Moderate	-	-
Petroica boodang	Scarlet Robin	Moderate	-	-
Petroica phoenicea	Flame Robin	Moderate	-	-

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Phoniscus papuensis	Golden-tipped Bat	High	-	-
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	High	-	-
Pseudomys novaehollandiae	New Holland Mouse	High	-	-
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	High	-	-
Ptilinopus superbus	Superb Fruit-Dove	Moderate	-	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	High	-	-
Scoteanax rueppellii	Greater Broad-nosed Bat	High	-	-
Tyto longimembris	Eastern Grass Owl	Moderate	-	-
Varanus rosenbergi	Rosenberg's Goanna	High	-	-

Table 5.2 Predicted ecosystem credit species excluded from further assessment

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Botaurus poiciloptilus	Australasian Bittern	Moderate	Waterbodies: Brackish or freshwater wetlands	Although the study area contains areas mapped as upland swamp, the site lacks any semi-permanent or ephemeral wet areas suitable for the species. There are no areas with standing water and emergent aquatic vegetation. The study area does not contain any wetland areas.
Ixobrychus flavicollis	Black Bittern	Moderate	Waterbodies: land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation.	No suitable waterbodies or wetlands occur within or in proximity to the site.
Rostratula australis	Australian Painted Snipe	Moderate	Within 5 km of Homebush Bay.	The study area is not within 5 km of Homebush Bay.

5.4 Species credit species

5.4.1 Candidate species assessment (Steps 1–3)

Candidate species that were considered for further assessment are shown in Table 5.3. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2) of the BAM (DPIE 2020a). Species assessed as candidate species here require further consideration and assessment in Steps 4 to 6 of the BAM (DPIE 2020a).

Table 5.3 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Acacia bynoeana	Bynoe's Wattle	N/A	N/A	Yes	Yes	The study area contains suitable heath and dry sclerophyll forest on sandy soils.	High	E	V
Acacia pubescens	Downy Wattle	N/A	N/A	No	No	This species occurs on alluvial soils, shales, and at the intergrade between shales and sandstones. The study area lacks the shale influenced soils habitats that this species is usually associated with (DPIE 2020b)	High	V	V
Acacia terminalis subsp. Eastern Sydney	Sunshine wattle	N/A	N/A	Yes	No	Although the study area contains suitable woodland habitat on sandy soils, this species has a highly restricted distribution in coastal areas from the northern shores of Sydney Harbour to Botany Bay (DPIE 2020b). Further justification is provided following this table.	Moderate	E	E
Allocasuarina portuensis	Nielsen Park She-oak	East of Gladesville Bridge, within 5 km of Sydney Harbour foreshore	No	N/A	No	The study area is outside the geographic constraints for this species.	High	E	E
Astrotricha crassifolia	Thick-leaf Star-hair	N/A	N/A	Yes	Yes	The study area contains suitable dry sclerophyll woodland on sandstone.	Very High	V	V
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs.	Yes	Yes	Yes	The study area contains suitable open woodland habitat with fallen timber.	High	E	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Callistemon linearifolius	Netted Bottle Brush	N/A	N/A	Yes	Yes	The study area contains suitable dry sclerophyll woodland.	Moderate	V	-
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	Hollow bearing trees: Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger.	Yes	Yes	Yes	Study area contains suitable foraging habitat, with some potential breeding hollows present.	High	E	E
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo (breeding)	Hollow bearing trees: Living or dead tree with hollows greater than 15 cm diameter and higher than 8 m above the ground.	No	N/A	No	No suitable breeding hollows for this species were recorded within the study area. All hollows within the study area are less than 5 m above the ground.	High	V	V
Cercartetus nanus	Eastern Pygmy-possum	N/A	N/A	Yes	Yes	Study area contains suitable woodland and heath habitat for this species.	High	V	-
Chalinolobus dwyeri	Large-eared Pied Bat	Cliffs: Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.	Yes	Yes	Yes	There is potential for suitable breeding habitat to occur within 2 km of the study area, in Strickland State Forest, and the study area contains suitable open woodland habitat.	Very High	E	E
Cryptostylis hunteriana	Leafless Tongue Orchid	N/A	N/A	Yes	Yes	The study area contains suitable swamp heath and woodland habitat.	Moderate	V	V

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Darwinia biflora	-	N/A	N/A	No	No	This species occurs on shale-capped ridges, at the intergrade of shale with Hawkesbury Sandstone. The study area lacks the shale-sandstone geology that this species is usually associated with, as there is no evidence of shale lenses within the subject land (DPIE 2020b) and the boundary of the Wianamatta shale group is 30km south of the study area. Additionally, the study area is outside the recorded range of the species. The northern and eastern limits of the known range are at Maroota and Kellyville, both to the southwest of the study area (DPIE 2020b).	High	V	V
Darwinia glaucophylla	-	Rocky areas: rocky platforms or within 100 m.	Yes	Yes	Yes	The study area contains suitable sandy heath and woodland habitat, associated with sandstone.	Moderate	V	-
Darwinia peduncularis	-	Rocky areas: or within 50 m of rocky areas.	Yes	Yes	Yes	There are some rocky areas within the site, and the study area contains suitable sandy soils over sandstone.	High	V	-
Dasyornis brachypterus	Eastern Bristlebird	N/A	N/A	Yes	Yes	The study area contains suitable dense vegetation, including open woodland with a heathy understorey.	Moderate	E	E

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Epacris purpurascens var. *purpurascens*	-	N/A	N/A	No	No	This species is found in areas with a strong shale influence. The study area lacks the shale soil influence that this species is usually associated with, as it is within an area of Hawkesbury Sandstone, and there is no evidence of shale lenses (DPIE 2020b).	Moderate	V	-
Eucalyptus camfieldii	Camfield's Stringybark	N/A	N/A	Yes	Yes	The study area contains suitable coastal heath, with sandy soils overlying Hawkesbury sandstone.	High	V	V
Genoplesium baueri	Bauer's Midge Orchid	N/A	N/A	Yes	Yes	The study area contains suitable dry sclerophyll forest on sandstone.	Very High	E	E
Grevillea caleyi	Caley's Grevillea	Laterite soils located on ridgetops or within 100 m. East of Pacific Highway, south of Broken Bay.	No	N/A	No	Although some lateritic soils are present in the broader site, the study area is outside the geographic constraints of this species.	High	CE	CE
Grevillea parviflora subsp. *supplicans*	-	N/A	N/A	Yes	Yes	The study area contains suitable heathy woodland on sandy soils over sandstone.	High	E	-
Grevillea shiressii	-	Central Coast LGA	Yes	Yes	Yes	The study area contains marginal habitat for this species and is within the Central Coast LGA.	Moderate	V	V

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	Yes	Yes	Yes	Although the study area is approximately 2.5 km from large areas of open water, Fountain Creek occurs within the broader site, to the south of the study area. The Upper and Lower Gosford Railway dams are two online waterbodies associated with Fountain Creek. There is some potential for breeding habitat on site.	High	V	-
Haloragodendron lucasii	-	Seepage zone or within 100 m. East of the Pacific Highway and South of Broken Bay.	No	N/A	No	The study area is outside the geographic constraints of this species.	Very High	E	E
Heleioporus australiacus	Giant Burrowing Frog	N/A	N/A	Yes	Yes	The study area contains suitable heath and woodland habitat, including waterways with potential breeding habitat.	Moderate	V	V
Hibbertia procumbens	Spreading Guinea Flower	Central Coast LGA	Yes	Yes	Yes	The study area contains suitable scrub/heath habitat and associations with swamps, and is within the Central Coast LGA.	High	E	-
Hibbertia puberula	-	N/A	N/A	Yes	Yes	The study area contains suitable sandy soil and dry sclerophyll woodland habitat.	High	E	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Hibbertia spanantha	Julian's Hibbertia	N/A	N/A	No	No	This species is associated with light clay soils in shale sandstone transition habitats. The study area lacks the shale-sandstone soils the species is associated with (DPIE 2020b). The study area sits within Hawkesbury sandstone and contains predominantly sandy soils. There is no evidence of shale lenses and the edge of the Wianamatta shale group is approximately 30km to the south of the site.	High	CE	CE
Hibbertia superans	-	N/A	N/A	Yes	Yes	The study area contains marginal habitat for the species, although it usually occurs near a shale/sandstone boundary which is not present in the study area.	High	E	-
Hieraaetus morphnoides	Little Eagle (breeding)	Nest trees – live (occasionally dead) large old trees within vegetation.	Yes	Yes	Yes	The study area contains suitable eucalypt woodland for the species with potential nest trees.	Moderate	V	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Hoplocephalus bungaroides	Broad-headed Snake (breeding)	Rocky areas: including escarpments, outcrops and pagodas within the Sydney Sandstone geologies.	Yes	Yes	Yes	There are some areas of rocky habitat within the study area. Generally, these areas lack exfoliating rock required by the species. During autumn, winter and spring this species shelters on exposed cliff edges in rock crevices and under flat sandstone rocks. In summer it moves into crevices or hollows in large trees within 500 m of escarpments (DPIE 2020b). The study area lacks any exposed cliff edges so does not provide suitable habitat for the species most of the year. The species may use the site during summer months and has been retained as a candidate species with this in mind.	Very High	E	E
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Other: requires dense ground cover in a variety of habitats.	Yes	Yes	Yes	The study area contains suitable heath and open forest habitat with heathy understorey. There is dense groundcover present in some areas of the site.	High	E	E
Kunzea rupestris	-	Rocky areas: Hawkesbury sandstone rock platforms or within 50 m.	Yes	Yes	Yes	The study area contains suitable shrubland habitat on Hawkesbury sandstone.	High	V	V
Lasiopetalum joyceae	-	N/A	N/A	Yes	Yes	The study area contains suitable heath habitat on sandstone.	Moderate	V	V

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Lathamus discolor	Swift Parrot (important habitat)	As per important habitat map.	No	N/A	No	Study area is outside the mapped important areas for this species.	Moderate	E	CE
Leptospermum deanei	-	Waterbodies: or within 100 m of freshwater or estuarine streams.	Yes	Yes	Yes	The study area contains drainage lines with sandy soils that may provide suitable habitat for the species.	High	V	V
Litoria aurea	Green and Golden Bell Frog	Semi-permanent/ ephemeral wet areas: within 1 km of wet area. Swamps: Within 1 km of swamp. Waterbodies: Within 1 km of waterbody.	Yes	No	No	Although the study area contains areas mapped as upland swamp, the site lacks any semi-permanent or ephemeral wet areas suitable for the species. There are no areas with standing water and emergent aquatic vegetation.	High	E	V
Lophoictinia isura	Square-tailed Kite (breeding)	Nest trees	Yes	Yes	Yes	The study area contains suitable woodland habitat with potential nest trees.	Moderate	V	-
Melaleuca deanei	Deane's Paperbark	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat.	Very High	V	V
Melaleuca groveana	Grove's Paperbark	N/A	N/A	Yes	Yes	The study area contains suitable heath and shrubland habitat.	High	V	-
Meridolum maryae	Maroubra Woodland Snail	N/A	N/A	Yes	Yes	The study area contains potential heathland habitat for the species.	High	E	E

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Micromyrtus blakelyi	-	Other: skeletal soil. Rocky areas: Hawkesbury sandstone rock platforms and outcrops or within 50 m.	Yes	Yes	Yes	The study area contains areas of shallow sandy soils with heathland on rock platforms and outcrops.	Moderate	V	V
Microtis angusii	Angus's Onion Orchid	N/A	N/A	No	No	This species is restricted to specific vegetation types located in the Ingleside and Terrey Hills area, all within the Northern Beaches LGA. All confirmed records of this species are in disturbed areas in modified soils such as road verges (DPIE 2020b). Further justification is provided following this table.	Moderate	E	E
Miniopterus australis	Little Bent-winged Bat (breeding)	Caves: 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.	No	N/A	No	Although the study area contains foraging habitat for this species, the site lacks the structures required for breeding.	Very High	V	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	Caves: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC – in cave;" observation type code "E nest-roost;" with numbers of individuals >500.	No	N/A	No	Although the study area contains suitable foraging habitat for this species, the site lacks the structures required for breeding.	Very High	V	-
Mixophyes iteratus	Giant Barred Frog	Land within 50 m of semi-permanent and permanent drainages.	No	N/A	No	The study area does not contain any permanent drainages or watercourses to provide suitable habitat for this species. The species prefers rainforest and wet sclerophyll habitats that are not present within the study area.	Moderate	V	V
Myotis macropus	Southern Myotis	Waterbodies: Waterbodies with permanent pools/stretches 3 m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies, on or within 200 m of the site.	No	N/A	No	There are no waterways or dams within 200 m of the study area that would provide potential foraging habitat for the species. Fountain Creek does not pass within 200 m of the subject land, and the section of this creek nearest to the subject land is unlikely to support pools that are wider than 3 m.	High	V	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Nettapus coromandelianus	Cotton Pygmy-Goose	Waterbodies: deep permanent fresh waters on floodplains with floating and submergent vegetation.	No	N/A	No	Although the study area contains areas mapped as upland swamp, the site lacks any deep permanent waterbodies with floating and submergent vegetation suitable for the species.	Moderate	E	-
Ninox connivens	Barking Owl	Hollow bearing trees: living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	Yes	Yes	Yes	The study area contains suitable woodland habitat with hollow bearing trees.	High	V	-
Ninox strenua	Powerful Owl	Hollow bearing trees: Living or dead trees with hollow greater than 20 cm diameter and greater than 4 m above the ground.	Yes	Yes	Yes	The study area contains suitable woodland habitat with hollow bearing trees.	High	V	-
Notamacropus parma	Parma Wallaby	N/A	N/A	Yes	Yes	The study area contains marginal habitat for this species.	High	V	V
Pandion cristatus	Eastern Osprey (breeding)	Presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.	No	N/A	No	The study area is too far from floodplain areas to provide suitable breeding habitat. No stick nests were recorded in the study area.	Moderate	V	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Perameles nasuta - endangered population	Long-nosed Bandicoot, North Head	South of Addison Road Manly Headland, including Sydney Harbour National Park (north).	No	N/A	No	The study area is outside the geographic constraint for this endangered population.	High	EP	-
Persoonia hirsuta	Hairy Geebung	N/A	N/A	Yes	Yes	The study area contains suitable heath and woodland habitat, on Hawkesbury sandstone.	High	E	E
Persoonia mollis subsp. *maxima*	-	N/A	N/A	No	No	This species occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone. These conditions are not present within the study area (DPIE 2020b).	High	E	E
Petalura gigantea	Giant Dragonfly	Swamps: within 500 m of swamps.	Yes	Yes	Yes	The study area contains suitable swamp habitat for this species.	Very High	E	-
Petauroides volans	Southern Greater Glider	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat for this species.	High	E	E
Petaurus norfolcensis	Squirrel Glider	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat for this species.	High	V	-
Petaurus norfolcensis - endangered population	Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	Barrenjoey Peninsula	No	N/A	No	The study area is not on the Barrenjoey Peninsula, and therefor outside the geographic constraints for this endangered population.	High	EP	-
Pezoporus wallicus wallicus	Eastern Ground Parrot	N/A	N/A	Yes	Yes	The study area contains marginal heathland habitat for this species.	High	V	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Phascolarctos cinereus	Koala	Presence of koala use trees – refer to Survey Comments field in TBDC.	Yes	Yes	Yes	The study area contains suitable eucalypt woodland habitat for Koalas, including Koala use trees identified for the Central Coast, including Red Bloodwood (*Corymbia gummifera*), Blue-leaved Stringybark (*Eucalyptus agglomerata*), Broad-leaved Scribbly Gum (*Eucalyptus haemastoma*), and Silvertop Ash (*Eucalyptus sieberi*). These species are considered rank 3 (significant use (feed or shelter trees)) or rank 4 irregular or (low use (feed or shelter trees)) species for the Central Coast region (DPE 2022b).	High	E	E
Pimelea curviflora var. *curviflora*	-	N/A	N/A	No	No	This species occurs on shale soils and shale/sandstone transition soils. These conditions are not present in the study area (DPIE 2020b).	High	V	V
Pommerhelix duralensis	Dural Land Snail	N/A	N/A	No	No	This species is associated with shale influenced habitats, and occurs in shale transitional landscapes on the western and northwestern fringes of the Cumberland IBRA subregion (DPIE 2020b). Suitable habitat of shale derived soils required by this species are not present within the study area, with the edge of the Wianamatta Shale group approximately 30km to the south.	High	E	E

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Potorous tridactylus	Long-nosed Potoroo	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).	Yes	Yes	Yes	The study area contains potential heath and woodland habitat for this species.	High	V	V
Prostanthera askania	Tranquility Mintbush	North of the Hawkesbury River	Yes	No	No	The study area lacks the moist sclerophyll forest and warm temperate rainforest communities that this species prefers, although the study area is within the geographic constraints for the species (DPIE 2020b).	High	E	E
Prostanthera junonis	Somersby Mintbush	N/A	N/A	Yes	Yes	The study area contains suitable woodland and scrub habitat and is located on the Somersby Plateau where the species is restricted.	High	E	E
Prostanthera marifolia	Seaforth Mintbush	South of Broken Bay	No	No	No	The study area is outside the geographic constraints for the species. This species occurs within localised patches in clay-loam soils that are not present within the study area.	High	CE	CE
Pseudophryne australis	Red-crowned Toadlet	N/A	N/A	Yes	Yes	There is suitable open forest habitat for this species within the study area, as well as drainage lines and small waterways.	Moderate	V	-
Pteropus poliocephalus	Grey-headed Flying-fox (breeding)	Other: breeding camps.	No	N/A	No	There are no breeding camps within the study area.	High	V	V

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Rhizanthella slateri	Eastern Australian Underground Orchid	N/A	N/A	Yes	Yes	The study area contains potentially suitable sclerophyll forest for the species.	High	V	E
Rhodamnia rubescens	Scrub Turpentine	N/A	N/A	No	No	The study area lacks the wet sclerophyll forest and warm temperate rainforest communities that this species prefers (DPIE 2020b).	Very High	CE	CE
Rhodomyrtus psidioides	Native Guava	N/A	N/A	No	No	The study area lacks the wet sclerophyll forest and warm temperate rainforest communities that this species prefers (DPIE 2020b).	Very High	CE	CE
Tetratheca glandulosa	-	N/A	N/A	No	No	This species is associated with shale-sandstone transition habitat where shale capping occurs over sandstone. There is no evidence of shale lensing in the study area, and study area lacks the shale-sandstone transition habitat that this species is associated with (DPIE 2020b), with the boundary of the Wianamatta shale group approximately 30km to the south.	High	V	-
Turnix maculosus	Red-backed Button-quail	N/A	N/A	Yes	Yes	The study area contains some marginal woodland habitat for this species.	High	V	-
Tyto novaehollandiae	Masked Owl	Hollow bearing trees: living or dead trees with hollows greater than 20 cm diameter that occurs >4 m above the ground.	Yes	Yes	Yes	The study area contains suitable woodland habitat with hollow bearing trees.	High	V	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Tyto tenebricosa	Sooty Owl	Caves. Cliffs: including clifflines/ledges. Escarpments: including clifflines/ledges. Hollow bearing trees: a living or dead tree with a hollow greater than 20 cm diameter that occurs >4 m above the ground.	Yes	No	No	This species inhabits wet sclerophyll forests and rainforests, and roosts in tall forest trees in gullies DPIE 2020b). These habitats are not present within the study area.	Very High	V	-
Vespadelus troughtoni	Eastern Cave Bat	Caves: within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	Yes	Yes	Yes	The study area contains foraging habitat for this species, and there is potential for breeding habitat on ridges within 2 km, particularly within Strickland State Forest.	Very High	V	-
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell in the LGAs of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	LGAs: Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield.	No	N/A	No	The study area is not in any of the LGAs listed for this endangered population.	High	EP	-

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Zieria involucrata	-	N/A	N/A	Yes	Yes	The study area contains marginal habitat for this species, although it usually prefers more sheltered forests on lower slopes.	High	E	V

Note

1. V = vulnerable, E = endangered, CE = critically endangered, EP = endangered population

i Further justification for candidate species assessment

a Sunshine Wattle (*Acacia terminalis* subsp. Eastern Sydney)

Acacia terminalis subsp. Eastern Sydney has a very restricted distribution that extends for approximately 23 km from the northern shores of Sydney Harbour to Botany Bay. Outside of this distribution, intermediates between *A. terminalis subsp. Eastern Sydney* and other subspecies of *A. terminalis* have been recorded in nearby local areas, with a likely dispersal ability of 300 m from local populations (DECCW 2010a). Therefore, it is highly unlikely that a separate, unknown population of this species would occur on the Central Coast region, and if any suspected *A. terminalis subsp. Eastern Sydney* individuals did occur, they would be more likely to be intermediates. The Central Coast region is highly developed and well surveyed, and it is therefore highly unlikely that a population of this species would remain undetected.

Furthermore, while the survey period is only from May to July, bipinnate Acacia species can be identified all year round, and *Acacia terminalis* is easily identifiable from other local Acacia species with its foliage that is shiny and dark green above and paler below (DECCW 2010a). Some *Acacia terminalis* was identified during plot surveys. *Acacia terminalis subsp. Eastern Sydney* is particularly identifiable with denser short hairs on branchlets (DECCW 2010a), than other subspecies of *Acacia terminalis*. Had anything fitting this description been detected during any survey, botanists would have returned during the correct survey period for *A. terminalis subsp. Eastern Sydney*.

b Angus's Onion Orchid (*Microtis angusii*)

All currently known records of *Microtis angusii* are located within Northern Beaches LGA. It is known from one small population in a roadside reserve at Ingleside in northern Sydney (DECCW 2010b). While this does not explicitly exclude the possibility of this species occurring within the subject land, the possibility of a previously undetected population occurring in the Central Coast region, a region that is highly developed and well surveyed, is unlikely. *Microtis* species typically reproduce vegetatively by the formation of “daughter” tubers from the main tuber (DPIE 2020b) and it is therefore unlikely that a population occurs on the Central Coast, considering that the only known population occurs on the Northern Beaches and a significant water body (the Hawkesbury River) presents a large natural barrier to vegetative dispersal.

Furthermore, the known Ingleside population occurs on soils that were originally those of the restricted ridgetop lateritic soils in the Duffy’s Forest - Terrey Hills - Ingleside and Belrose areas. These soils support a specific and distinct vegetation type, the Duffy’s Forest Vegetation Community, which does not occur within the subject land partly due to a lack of suitable geology (see Section 4.3.5ii). Again, it is unlikely that the sandy soils within the subject land are supportive of this highly localised orchid species.

The original soil landscape at the known population consists of soils that are distinctly orange-red and gravelly, consisting of red and yellow earths with orange-red iron rich pebbles and gravels. At the known locality the soil has been modified. The degree of modification is unclear although at least on one occasion the site has been used to dump sand and has possibly been used as a fill site in the past. *Microtis angusii* has only been found in modified soils (DECCW 2010b). The subject land contains intact, sandy soils that appear unsuitable for this species.

5.4.2 Species requiring further assessment (Step 4)

Species listed as Candidate species in Table 5.3 require further assessment under the BAM (after completing Steps 2 and 3). The species are considered to have potential of occurring within the study area, and their presence has been assessed through targeted surveys.

Table 5.4 outlines which species were found to be present, and a summary of the surveys undertaken as part of the assessment. Survey effort by both EMM and Umwelt are included, including some survey efforts that are beyond the five year survey limit outlined in the BAM. Only the more recent datasets were used to meet survey guidelines (detailed in section 5.4.3), however older surveys are included to demonstrate the extent of survey completed at the site.

There have been no major changes to the site since surveys began in 2018, so the survey outcomes remain relevant as the habitat and conditions are largely unchanged (Section 4.3.2). Results from surveys over the years are consistent, with largely the same set of species detected by EMM in more recent surveys as were detected by Umwelt in earlier surveys.

Table 5.4 Assessment of candidate species presence within the subject land

Scientific name	Common name	Present in the subject land?	Survey methods	Timing of survey undertaken (included in BAM-C assessment)	Additional prior survey efforts during survey season (not included in BAM-C)
Acacia bynoeana	Bynoe's Wattle	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Astrotricha crassifolia	Thick-leaf Star-hair	No	Targeted flora surveys	November 2019; November 2023	August 2018; October 2018
Burhinus grallarius	Bush Stone-curlew	No	Spotlighting, call playback	January 2024; February 2024	March 2019; May 2019; March 2020
Callistemon linearifolius	Netted Bottle Brush	No	Targeted flora surveys	November 2019; November 2023	October 2018; January 2019
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	No	Diurnal bird surveys, habitat assessment and hollow surveys	October 2023	March 2019; May 2019; March 2020
Cercartetus nanus	Eastern Pygmy-possum	Yes (recorded)	Spotlighting, remote cameras	January 2024; February 2024	March 2019; May 2019; March 2020
Chalinolobus dwyeri	Large-eared Pied Bat	Yes (recorded)	Anabat surveys (acoustic detection), harp trapping	November 2023; January 2024	-
Cryptostylis hunteriana	Leafless Tongue Orchid	No	Targeted flora surveys	November 2019; November 2023	January 2019
Darwinia glaucophylla	-	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Darwinia peduncularis	-	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Dasyornis brachypterus	Eastern Bristlebird	No	Diurnal bird surveys	October 2023	-
Eucalyptus camfieldii	Camfield's Stringybark	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019

Scientific name	Common name	Present in the subject land?	Survey methods	Timing of survey undertaken (included in BAM-C assessment)	Additional prior survey efforts during survey season (not included in BAM-C)
Genoplesium baueri	Bauer's Midge Orchid	No	Targeted flora surveys	February 2024	-
Grevillea parviflora subsp. *supplicans*	-	No	Targeted flora surveys	November 2019; November 2023	August 2018; October 2018
Grevillea shiressii	-	No	Targeted flora surveys	November 2019; November 2023	August 2018; October 2018
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	No	Habitat surveys	October 2023	August 2018; October 2018; March 2019; May 2019
Heleioporus australiacus	Giant Burrowing Frog	Yes (recorded)	Spotlighting, call playback	January 2024	March 2019; May 2019; March 2020
Hibbertia procumbens	Spreading Guinea Flower	Yes (recorded)	Targeted flora surveys	November 2019; November 2023	October 2018; January 2019
Hibbertia puberula	-	Yes (recorded)	Targeted flora surveys	November 2019; November 2023	October 2018
Hibbertia superans	-	No	Targeted flora surveys	November 2019; November 2023	August 2018; October 2018
Hieraaetus morphnoides	Little Eagle (breeding)	No	Habitat surveys	October 2023	August 2018; October 2018; March 2019; May 2019
Hoplocephalus bungaroides	Broad-headed Snake (breeding)	No	Habitat searches, spotlighting	January 2024; February 2024	August 2018
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	No	Spotlighting	January 2024; February 2024	-
Kunzea rupestris	-	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Lasiopetalum joyceae	-	No	Targeted flora surveys	November 2019; November 2023	October 2018
Leptospermum deanei	-	No	Targeted flora surveys	November 2019; November 2023	October 2018
Lophoictinia isura	Square-tailed Kite (breeding)	No	Habitat surveys	October 2023	October 2018; January 2019; March 2019; May 2019
Melaleuca deanei	Deane's Paperbark	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Melaleuca groveana	Grove's Paperbark	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019

Scientific name	Common name	Present in the subject land?	Survey methods	Timing of survey undertaken (included in BAM-C assessment)	Additional prior survey efforts during survey season (not included in BAM-C)
Meridolum maryae	Maroubra Woodland Snail	No	Habitat searches	October 2023; March 2024	-
Micromyrtus blakelyi	-	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Ninox connivens	Barking Owl	No	Call playback, stag watching, habitat surveys	May 2019; January 2024; February 2024; March 2024; April 2024	August 2018, March 2019; March 2020
Ninox strenua	Powerful Owl	No	Call playback, stag watching, habitat surveys	May 2019; January 2024; February 2024; March 2024; April 2024	August 2018, March 2019; March 2020
Notamacropus parma	Parma Wallaby	No	Spotlighting, remote cameras	January 2024; February 2024	March 2019; May 2019; March 2020
Persoonia hirsuta	Hairy Geebung	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019
Petalura gigantea	Giant Dragonfly	No	Habitat searches	January 2024	January 2019
Petauroides volans	Greater Glider	No	Spotlighting	January 2024; February 2024	March 2019; May 2019; March 2020
Petaurus norfolcensis	Squirrel Glider	Yes (recorded)	Spotlighting	January 2024; February 2024	March 2019; May 2019; March 2020
Pezoporus wallicus wallicus	Eastern Ground Parrot	No	Dawn bird surveys	October 2023	-
Phascolarctos cinereus	Koala	No	SATs, spotlighting	October 2023; January 2024; February 2024; March 2024	March 2019; May 2019; March 2020
Potorous tridactylus	Long-nosed Potoroo	No	Spotlighting	January 2024; February 2024	-
Prostanthera junonis	Somersby Mintbush	No	Targeted flora surveys	November 2019; November 2023	October 2018
Pseudophryne australis	Red-crowned Toadlet	Yes (recorded)	Spotlighting, call playback	January 2024; February 2024	March 2019; May 2019; March 2020
Rhizanthella slateri	Eastern Australian Underground Orchid	No	Targeted flora surveys	November 2019; November 2023	October 2018
Turnix maculosus	Red-backed Button-quail	No	Dawn surveys, spotlighting	October 2023; January 2024; February 2024	August 2018; October 2018; January 2019; March 2020
Tyto novaehollandiae	Masked Owl	No	Call playback, habitat surveys	May 2019; January 2024; February 2024; March 2024; April 2024	August 2018, March 2019; March 2020

Scientific name	Common name	Present in the subject land?	Survey methods	Timing of survey undertaken (included in BAM-C assessment)	Additional prior survey efforts during survey season (not included in BAM-C)
Vespadelus troughtoni	Eastern Cave Bat	No	Anabats (acoustic detection), harp trapping, habitat assessments	November 2023; January 2024	-
Zieria involucrata	-	No	Targeted flora surveys	November 2019; March 2020; November 2023; February 2024	August 2018; October 2018; January 2019

5.4.3 Candidate species survey methods

Umwelt completed a suite of targeted surveys at the site between August 2018 and March 2020, based on a previous iteration of the study area. Some of those surveys were completed as part of the Central Coast Strategic Conservation Plan (CCSCP) and some were part of the previous BCAR completed for this site at Somersby (Umwelt 2020). Details of which survey efforts have been applied to this assessment are outlined in the sections below. EMM undertook additional field surveys in 2023 and 2024 in order to meet the requirements of the BAM, in part due to changes to the study area. The species records from all previous surveys have been considered and included in this report.

Targeted surveys were undertaken by Umwelt with due reference to guidelines applicable at the time of survey, including:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (NSW DEC 2004)
- Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (DECC 2009)
- NSW Guide to Surveying Threatened Plants (OEH 2016)
- Surveying Threatened Plants and Their Habitats (DPIE 2020c).

EMM undertook additional surveys in 2023 and 2024 with reference to current threatened plant and frog survey guidelines, including:

- 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method (DPIE 2021)
- NSW Survey Guide for Threatened Frogs: A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method (DPIE 2020d)
- Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE 2022c)
- Threatened reptiles: Biodiversity Assessment Method survey guide (DPE 2022d)
- Updates to owl survey guidelines released March 2024 in the TBDC (DPIE 2020b).

A summary of field surveys completed on the site is outlined in Table 5.5. EMM has incorporated the findings of these surveys into the assessments of species presence where appropriate. As in Section 5.4.2, survey effort by both EMM and Umwelt are included. Only the more recent datasets were used to meet survey guidelines (detailed in the following sections), however older surveys are included below to demonstrate the extent of survey completed at the site.

Table 5.5 Summary of species credit species surveys

Survey date	Method	Species targeted
27-28 August 2018 (Umwelt)	Spotlighting and call playback	Barking Owl, Masked Owl, Powerful Owl, Sooty Owl
	Habitat assessments (evidence of breeding)	White-bellied Sea-eagle, Little Eagle, Square-tailed Kite, Eastern Osprey
	Targeted threatened species transects and habitat assessments	Broad-headed Snake, Rough Doubletail
31 October 2018 (Umwelt)	Targeted threatened flora transects	Spreading Guinea Flower, Somersby Mintbush, Eastern Underground Orchid, *Tetratheca glandulosa*
22-23 January 2019 (Umwelt)	Targeted threatened species transects	Giant Dragonfly
	Targeted threatened flora transects	Bynoe's Wattle, Thick-leaf Star-hair, Netted Bottle Brush, Leafless Tongue Orchid, *Darwinia glaucophylla*, Camfield's Stringybark, Bauer's Midge Orchid, *Grevillea shiressii*, Grove's Paperbark, Hairy Geebung
25-28 March 2019 (Umwelt)	Nocturnal searches, Call-playback, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo), Koala SAT tests, Microhabitat breeding habitat assessment	Bush Stone-curlew, Gang-gang Cockatoo, Glossy Black-Cockatoo, Large-eared Pied Bat, Giant Burrowing Frog, Green and Golden Bell Frog, Giant Barred Frog, Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis, Koala, Red-crowned Toadlet, Grey-headed Flying-fox, Eastern Cave Bat
25 March - 6 May 2019 (Umwelt)	Remote camera	Eastern Pygmy-possum, Parma Wallaby, Squirrel Glider
6-8 May 2019 (Umwelt)	Nocturnal searches, Hollow bearing tree analysis, Call-playback, Stag watching, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo)	Gang-gang Cockatoo, Glossy Black-Cockatoo, Barking Owl, Masked Owl, Powerful Owl, Sooty Owl
27-28 November 2019 (Umwelt)	Targeted threatened flora transects	Bynoe's Wattle, Netted Bottle Brush, Camfield's Stringybark, Hairy Geebung, Spreading Guinea Flower, Somersby Mintbush
24-25 March 2020 (Umwelt)	Nocturnal searches, Call-playback, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo), Forest owl tree hollow searches	Eastern Pygmy-possum, Parma Wallaby, Squirrel Glider, Greater Glider, Koala, Green and Golden Bell Frog, Giant Barred Frog, Red-crowned Toadlet, Giant Burrowing Frog, Bush Stone-curlew
	Targeted threatened flora transects	Bynoe's Wattle, Netted Bottle Brush, Camfield's Stringybark, Hairy Geebung
15-16 May 2023 (EMM)	Habitat assessments	All fauna, especially species dependent on tree hollows or stick nests
19, 23-25 October 2023 (EMM)	Diurnal bird surveys, Habitat assessment, SATs	Diurnal birds, Koala, Habitat assessment for hollow dependent species and stick nests for raptors
	Acoustic surveys for microbats	Microbats

Survey date	Method	Species targeted
20-24 November 2023 (EMM)	Targeted flora surveys	Target species outlined in Section 5.4.3.i.
30 November 2023 (EMM)	Targeted flora surveys	Target species outlined in Section 5.4.3.i.
2-5 January 2024 (EMM)	Spotlighting, microbat roost habitat searches, harp trapping	Microbats, arboreal mammals, terrestrial mammals, frogs
29-30 January 2024 (EMM)	Giant Dragonfly searches, swamp mapping	Giant Dragonfly
19-22 February 2024 (EMM)	Spotlighting	Arboreal mammals, terrestrial mammals, frogs, reptiles, nocturnal birds
	Targeted flora surveys	Target species outlined in Section 5.4.3.i.
29 February – 1 March 2024 (EMM)	SAT surveys	Koala
21 March 2024 (EMM)	Owl call playback	Barking Owl, Masked Owl, Powerful Owl
2 April 2024 (EMM)	Owl call playback	Barking Owl, Masked Owl, Powerful Owl
15 April 2024 (EMM)	Owl call playback	Barking Owl, Masked Owl, Powerful Owl

i Use of data beyond five-year operational limit

This BCAR is preceded by a substantial body of work undertaken at the Somersby site over multiple years and multiple visits, as documented in this chapter. It is recognised that an operational limit of five years is placed on survey data to ensure the data reflects the current biodiversity values on the subject land (DPIE 2020b). Under these restrictions, some of the data and the completed surveys to date would not be usable.

The data that this BCAR has relied on is restricted to any work undertaken since 2019; any earlier work has not been relied on. It is acknowledged that survey works completed in 2019 would have expired on their corresponding date in 2024. While reliance has been placed on the more recent available data, the older work nevertheless informs a view about the ecological values of the site over time.

This BCAR demonstrates that:

- the data was collected within a reasonable timeframe (i.e. recently expired and not decades old)
- survey adequacy is met
- the site condition has not changed.

With respect to site condition, it is noted that the Reeves Street site has remained undeveloped and unchanged over the last five years as discussed in Section 4.3.2 (i.e. intact vegetation, no vegetation clearing, fires, or major disturbance).

It is also noted that the key findings of field survey since 2018 have been consistent with respect to threatened species findings (see next section) and vegetation mapping. EMM has recorded an additional three threatened species based on surveys conducted in 2023 and 2024. The only threatened species previously recorded (Umwelt 2020) that was not detected by EMM is the Squirrel Glider. The record for this species has still been included in this assessment and a species polygon has been generated (Section 5.4.5vi).

ii Targeted flora surveys

Targeted flora surveys were undertaken via parallel-transect technique across the subject land, targeting 23 candidate species with potential to occur on the site. Separation widths were determined by the life form of the target species. Cryptic herbs such as orchid species were searched using traverses set approximately at 5 m intervals; whereas all other species were targeted at 10 m intervals.

When a target species was found, further detailed searches to increase the intensity of survey effort were carried out in the area to map the population extent. The species and number of plants or clumps of plants were recorded, with detailed searches continuing until no more plants or clumps were recorded in the area.

Prior to survey, reference populations were used to confirm flowering of orchid species including Leafless Tongue Orchid (confirmation of flowering nearby was received on 20 November 2023, surveys commenced on the 22 November) and Bauer's Midge Orchid (flowering was confirmed at a reference site on the morning of surveys) and Somersby Mintbush (flowering confirmed on day of surveys).

Several specimens of species recorded on site were sent for confirmation by the herbarium, and all received positive confirmation (included in Appendix A):

- *Hibbertia puberula* (Australian National Botanic Gardens)
- *Hibbertia procumbens* (Botanic Gardens of Sydney)
- *Prostanthera junonis* (Botanic Gardens of Sydney).

Table 5.6 outlines the targeted survey efforts in the study area since 2018. This information was compiled from Umwelt (2020) and from the CCSCP GIS dataset provided to EMM by Darkinjung LALC. The area covered by each of the survey efforts is described in Table 5.6, however EMM has only gained access to the spatial data collected by Umwelt as part of the CCSCP (August 2018, October 2018, January 2019, November 2019, and March 2020). EMM has not been provided with the complete datasets collected by Umwelt as part of their previous report (Umwelt 2020).

Surveys by Umwelt were completed based on a previous iteration of the study area that was smaller than the current study area. Targeted surveys completed by EMM were carried out in areas that were either not included in the previous footprint or in survey seasons that had not been covered by previous efforts.

In order to meet the BAM guidelines, four survey efforts were relied upon: November 2019, March 2020, November 2023 and February 2024 (highlighted dark grey in Table 5.7). Although these four efforts alone provide survey coverage for the whole study area within the survey seasons of target species (Figure 5.1), a considerable amount more targeted surveys have been completed within the study area since 2018. This BCAR contains all threatened species records included in Umwelt (2020), i.e. the results of all Umwelt's survey effort from 2018 onwards, as well as species recorded by EMM.

Table 5.7 shows which survey efforts were carried out within the specified survey months for each candidate threatened flora species.

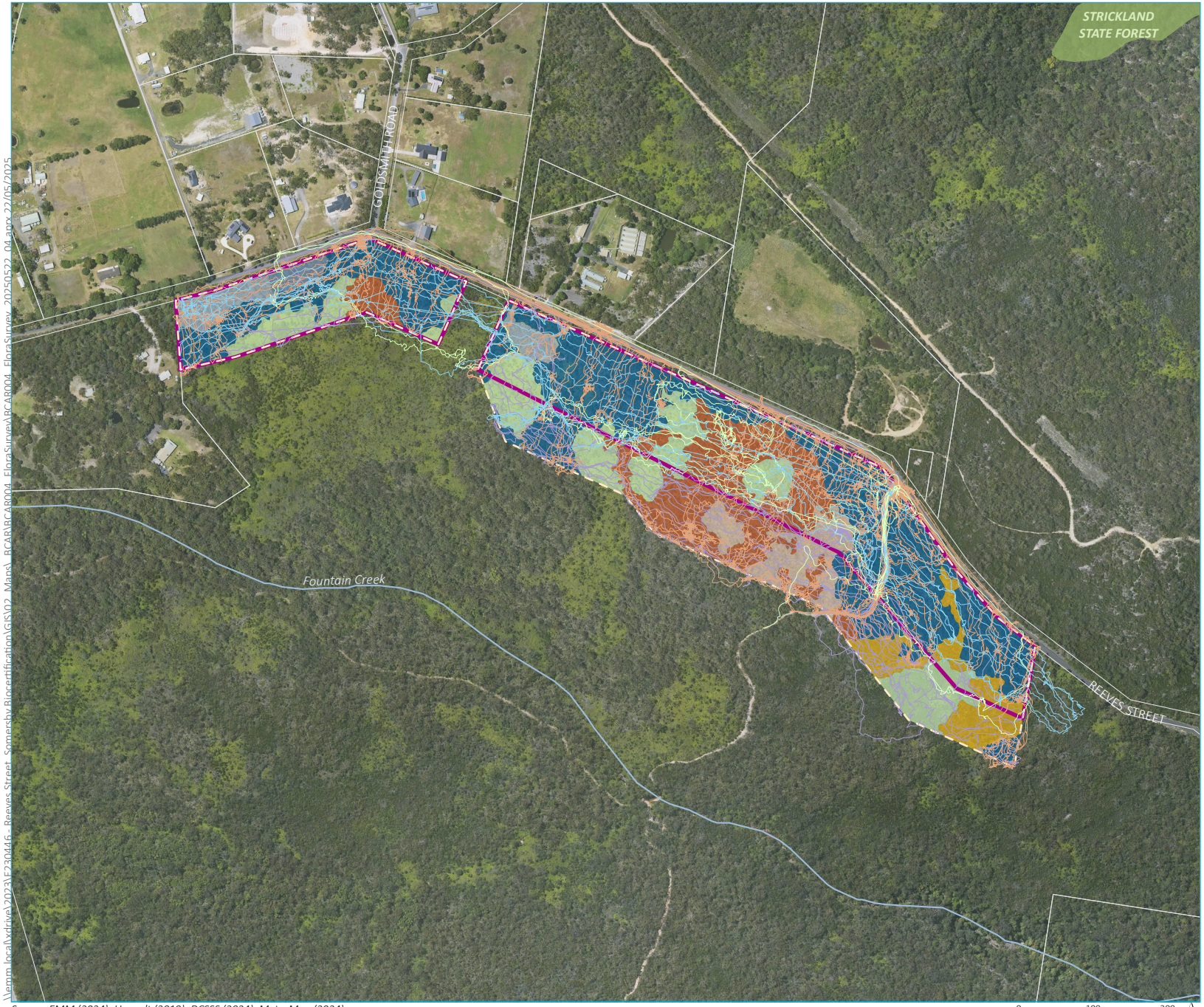
Table 5.6 Flora survey efforts

Date	Surveyed by	Location/coverage
27-28 August 2018	Umwelt	Coverage of previous study area, completed as part of CCSCP
31 October 2018	Umwelt	Partial coverage of previous study area, completed as part of CCSCP
21-22 January 2019	Umwelt	Coverage of previous study area except for a gap at the centre of the site, completed as part of CCSCP
25-28 November 2019	Umwelt	Coverage of previous study area, completed as part of CCSCP
24-25 March 2020	Umwelt	Coverage of some PCTs in previous study area, completed as part of CCSCP
22-24, 30 November 2023	EMM	Current study area (remaining area not covered in November 2019 surveys)
19-22 February 2024	EMM	Current study area (all PCT 3586 and PCT3593 across the site)

Table 5.7 Threatened flora survey efforts completed

Scientific name	Common name	Specified survey months	August 2018	October 2018	January 2019	November 2019 (used in this BCAR)	March 2020 (used in this BCAR)	November 2023 (used in this BCAR)	February 2024 (used in this BCAR)
Acacia bynoeana	Bynoe's Wattle	All year	X	X	X	X	X	X	X
Astrotricha crassifolia	Thick-leaf Star-hair	Jul-Dec	X	X		X		X	
Callistemon linearifolius	Netted Bottle Brush	Oct-Jan		X	X	X		X	
Cryptostylis hunteriana	Leafless Tongue Orchid	Nov-Jan			X	X		X	
Darwinia glaucophylla	-	All year	X	X	X	X	X	X	X
Darwinia peduncularis	-	All year	X	X	X	X	X	X	X
Eucalyptus camfieldii	Camfield's Stringybark	All year	X	X	X	X	X	X	X
Genoplesium baueri	Bauer's Midge Orchid	Feb-Mar							X
Grevillea parviflora subsp. *supplicans*	-	Aug-Nov	X	X		X		X	
Grevillea shiressii	-	Jul-Dec	X	X		X		X	
Hibbertia procumbens	Spreading Guinea Flower	Oct-Jan		X	X	X		X	
Hibbertia puberula	-	Oct-Dec		X		X		X	
Hibbertia superans	-	Jul-Dec	X	X		X		X	
Kunzea rupestris	-	All year	X	X	X	X	X	X	X
Lasiopetalum joyceae	-	Sep-Nov		X		X		X	
Leptospermum deanei	-	Oct-Nov		X		X		X	
Melaleuca deanei	Deane's Paperbark	All year	X	X	X	X	X	X	X

Scientific name	Common name	Specified survey months	August 2018	October 2018	January 2019	November 2019 (used in this BCAR)	March 2020 (used in this BCAR)	November 2023 (used in this BCAR)	February 2024 (used in this BCAR)
Melaleuca groveana	Grove's Paperbark	All year	X	X	X	X	X	X	X
Micromyrtus blakelyi	-	All year	X	X	X	X	X	X	X
Persoonia hirsuta	Hairy Geebung	All year	X	X	X	X	X	X	X
Prostanthera junonis	Somersby Mintbush	Oct-Dec		X		X		X	
Rhizanthella slateri	Eastern Australian Underground Orchid	Sep-Nov		X		X		X	
Zieria involucrata	-	All year	X	X	X	X	X	X	X



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Source: EMM (2024); Umwelt (2019); DCSSS (2024); MetroMap (2024)

Flora survey effort

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 5.1

EMM
creating opportunities

iii Targeted fauna surveys

Details of the survey methods and effort completed for each target group are outlined in the sections below. Survey locations are shown in Figure 5.2, Figure 5.3 and Figure 5.4, and weather conditions during fauna surveys are provided in Appendix B.

a Arboreal mammals

Targeted surveys were conducted for the following candidate species:

- Eastern Pygmy-possum (*Cercartetus nanus*)
- Southern Greater Glider (*Petauroides volans*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*).

Umwelt completed the following surveys targeting arboreal mammals:

- Spotlighting surveys (March and May 2019, March 2020)
- Call playback surveys for Squirrel Glider and Koala (March 2019, March 2020)
- Remote camera surveys (March to May 2019)
- Spot Assessment Technique (SAT) searches (March 2019).

The surveys completed by Umwelt were not relied upon to meet the survey guidelines outlined in Table 5.8. EMM resurveyed the study area using spotlighting and additional Spot Assessment Technique (SAT) searches. Spotlighting surveys target all the above species, and SAT searches were completed to target Koala (Table 5.8). Survey effort is shown in Figure 5.2.

Spotlighting surveys generally consisted of traversing the length of the study area (approximately 1,200 m). Given the dense vegetation within the site, additional spotlighting effort was undertaken along Reeves St and along the access track within the study area, which allowed surveyors to move more quietly to detect animals. Several target species were recorded along these tracks, including Eastern Pygmy-possum. Spotlighting surveys were completed on foot by a team of two ecologists surveying opposite sides of the transect, moving at a speed of approximately 10 m/min, using 750-1,000 lumen torches.

An Eastern Pygmy-possum was recorded by EMM in the study area during spotlighting in January 2024. Although it is noted that spotlighting is not usually a reliable method for detecting Eastern Pygmy-possums, after one of the species was detected in the study area using this method, plans for additional survey methods targeting this species were not completed as no further data was required in order to define a species polygon. Its presence was assumed across all PCTs within the subject land, and the species polygon was mapped as such (Section 5.4.5i).

SATs were placed by drawing a 150 m grid over the study area in ArcGIS, with one SAT location placed at the intersection of each grid line. The ground and leaf litter around 30 trees were searched at each SAT location. No evidence of Koala scats was found.

Table 5.8 Arboreal mammal survey guidelines and effort

Target species	Recommended survey technique	Survey effort
• Eastern Pygmy-possum • Greater Glider • Squirrel Glider • Koala	Spotlighting: DSEWPaC (2011) recommends two 200 m transects per 5 ha site spaced at 100 m between transects, repeated on two separate nights (four transects in total). DEC (2004) recommends two transects per 200 ha of stratification unit, repeated across two nights. For Koala, two x 200 m transect per 5 ha, repeated over two nights (DPE 2022c). The effort required for the subject land is four x 200 m transects (800m) carried out over 80 minutes (1.3 hours).	Umwelt completed eight nights of spotlighting surveys in May 2019 and March 2020. They also completed call playback for Squirrel Glider and Koala over three nights in March 2019 and two nights in March 2020. A total of 930 minutes (15.5 hours) of spotlighting was completed by EMM over five nights in January and February 2024, by teams of two people. This is a total of 31 person hours. The total length of the spotlighting tracks was 14.9 km, with the team surveying between 1.5 and 3.7 km per night.
• Koala	SAT surveys: Survey locations should be placed using 150 m grid spacing for habitat <50 ha (DPE 2022c). This equates to eight SAT locations to cover the study area.	Three SAT surveys were completed by Umwelt in March 2019. EMM completed eight SAT surveys across the study area in October 2023 and March 2024.
• Eastern Pygmy-possum	Remote cameras: DEC (2004) does not include remote camera surveys. However, as cameras are used to replace hair tubes a similar survey effort can be utilised. DEC (2004) recommends ten hair tubes left in place for at least four days and nights per 50 ha stratification unit, with replication for every additional 100 ha. DSEWPaC (2011) recommends that ten cameras are deployed per hectare. To cover the study area (19.64 ha), this would require 196 cameras. This level of survey effort is considered unreasonable for this proposed rezoning.	Umwelt (2020) conducted remote camera surveys from March to May in 2019, in accordance with the following method: • At each site two cameras were placed at least 100 m apart. • Cameras were attached to tree or stake and positioned approximately 25 cm above ground with bait stations placed 1.5 m away. • Bait stations were baited with a mixture of peanut butter, rolled oats and honey. Cameras were placed at at-least 10 locations for a period of 43 nights.

Koala surveys – as per Koala survey guidelines (DPE 2022c)

Koalas are associated with all PCTs within the subject land. The habitat within the subject land is all continuous. Reeves Street separates the subject land from extensive areas of habitat to the north in Strickland State Forest. Debenham Road and the Central Coast Highway separates the study area from habitat to the south in Brisbane Water National Park (see Figure 3.2). While Reeves Street and Debenham Road probably do not present a significant barrier to koala movement, the Central Coast Highway is a much larger road and would likely present a barrier to koalas at busy times.

The study area is located within the Central Coast Koala modelling region. The corresponding list of Koala use trees was used to make the assessments of suitable habitat included in Table 5.9.

Table 5.9 Suitable Koala habitat within the study area

PCT	Koala use trees present?
PCT 3586 – Northern Sydney Scribbly Gum Woodland	Yes
PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest	Yes
PCT 3807 – Northern Sydney Heath-Mallee	Yes
PCT 3924 – Sydney Coastal Upland Swamp Heath	Yes

Spotlighting and SAT surveys were used to survey for Koalas in the subject land. These methods were deemed appropriate for the site given the relatively small study area, allowing suitable survey effort to be completed. Three SAT surveys were completed in the subject land in March 2019, although the data for these surveys was not received from Umwelt other than what was published in their report (Umwelt 2020). Additional SAT surveys were conducted in the study area by EMM in October 2023 and January 2024 to March 2024.

Spotlighting was chosen as a method due to the manageable size of the subject area and the relatively open canopy, providing visibility for spotlighting searches. Spotlighting surveys for Koalas were combined with survey efforts for Squirrel Glider (*Petaurus norfolcensis*) and Southern Greater Glider (*Petauroides volans*), as well as large terrestrial mammals.

Koala surveys were completed by Jason Brown and Ireni Clarke. The credentials and experience level of these surveyors can be found in Appendix B.

Details of the conditions during koala surveys are outlined in Table 5.10.

Table 5.10 Koala survey effort and conditions

Date	Survey method	Start time	Finish time	Rainfall (mm)	Rainfall (mm in previous 72 hrs)	Min temp (°C)	Max temp (°C)	Relative humidity (%)	Wind speed (km/h)
25/10/2023	SAT surveys	8am	2pm	0	0	14	23	75	17
2/1/2024	Spotlighting	22:44	00:31	0.6	5.2	19.2	27.6	65	19
3/1/2024	Spotlighting	21:21	00:57	0	5.8	18.6	28.1	63	19
4/1/2024	Spotlighting	21:18	00:57	0	4.8	19.4	28	81	20
5/1/2024	Spotlighting	20:58	01:09	3.6	0.6	21	24.4	66	11
21/2/2024	Spotlighting	20:13	22:31	10.4	30	18.9	26.9	72	13
29/2/2024	SAT surveys	8am	2pm	0	1.6	21.2	38.9	79	7
1/3/2024	SAT surveys	8am	2pm	0	1.6	22.7	28.2	84	4

Locations of SAT survey sites and of spotlighting tracks can be viewed in Figure 5.2.

SAT locations were placed over the study area by generating a 150 m grid in ArcGIS. One SAT was placed in the centre of each 150 m square. Table 5.11 details the outcome of each SAT survey.

Table 5.11 SAT survey results

SAT survey	Easting	Northing	Number of trees sampled	Scat present/absent
EMM 1	342480	6303408	30	Absent
EMM 2	342632	6303389	30	Absent
EMM 3	342784	6303246	30	Absent
SAT 4	342935	6303255	30	Absent
SAT 5	343092	6303095	30	Absent
SAT 6	342801	6303415	30	Absent
SAT 7	342504	6303531	30	Absent
SAT 8	342203	6303686	30	Absent

Spotlighting surveys generally consisted of traversing the length of the study area (approximately 1,200 m). Given the dense shrubby vegetation within the site, additional spotlighting effort was undertaken along Reeves Street and along the access track within the study area, which allowed surveyors to move more quietly to detect animals. Spotlighting surveys were completed on foot by a team of two ecologists surveying opposite sides of the transect, moving at a speed of approximately 10 m/min, using 750-1,000 lumen torches (LED Lenser H7R core, 15-1,000 lm).

No koalas, or evidence of koalas, were detected during the surveys.

b Terrestrial mammals

Targeted surveys were conducted for the following species:

- Southern Brown Bandicoot (*Isoodon obesulus obesulus*)
- Parma Wallaby (*Notamacropus parma*)
- Long-nosed Potoroo (*Potorous tridactylus*).

Umwelt completed the following surveys targeting terrestrial mammals:

- Remote camera surveys (March to May 2019)
- Spotlighting surveys (March and May 2019, March 2020).

The surveys completed by Umwelt were not relied upon to meet the survey guidelines outlined in Table 5.12. EMM resurveyed the study area using spotlighting, which targets all of the above species (Table 5.12, Figure 5.2). Spotlighting surveys generally consisted of traversing the length of the study area (approximately 1,200 m). Given the dense vegetation within the site, additional spotlighting effort was undertaken along Reeves St and along the access track within the study area, which allowed surveyors to move more quietly to detect animals.

Spotlighting surveys were completed on foot by a team of two ecologists surveying opposite sides of the transect, moving at a speed of approximately 10 m/min, using 750-1,000 lumen torches.

Table 5.12 Terrestrial mammal survey guidelines and effort

Target species	Recommended survey technique	Survey effort
• Southern Brown Bandicoot • Parma Wallaby • Long-nosed Potoroo	Spotlighting: DSEWPaC (2011) recommends two 200 m transects per 5 ha site spaced at 100 m between transects, repeated on two separate nights (four transects in total). DEC (2004) recommends two transects per 200 ha of stratification unit, repeated across two nights.	Umwelt completed eight nights of spotlighting surveys in May 2019 and March 2020. A total of 930 minutes (15.5 hours) of spotlighting was completed by EMM over five nights in January and February 2024, by teams of two people. This is a total of 31 person hours. The total length of the spotlighting tracks was 14.9 km, with the team surveying between 1.5 and 3.7 km per night.
• Southern Brown Bandicoot • Parma Wallaby • Long-nosed Potoroo	Remote cameras: DEC (2004) does not include remote camera surveys. However, as cameras are used to replace hair tubes a similar survey effort can be utilised. DEC (2004) recommends ten hair tubes left in place for at least four days and nights per 50 ha stratification unit, with replication for every additional 100 ha. DSEWPaC (2011) recommends that ten cameras are deployed per hectare. To cover the study area (19.64 ha), this would require 196 cameras. This level of survey effort is considered unreasonable for this proposed rezoning.	Umwelt (2020) conducted remote camera surveys from March to May in 2019, in accordance with the following method: • At each site two cameras were placed at least 100 m apart. • Cameras were attached to tree or stake and positioned approximately 25 cm above ground with bait stations placed 1.5 m away. • Bait stations were baited with a mixture of peanut butter, rolled oats and honey. Cameras were placed at at-least 10 locations for a period of 43 nights.

c Microchiropteran bats

Targeted surveys were conducted for the following species:

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Eastern Cave Bat (*Vespadelus troughtoni*).

EMM took a staged approach to microbat surveys, first completing acoustic detection surveys using anabat detectors (Table 5.13, Figure 5.2). Acoustic surveys recorded Large-eared Pied Bat, as well as calls that could be either from Eastern Cave Bat (*Vespadelus troughtoni*) or Little Forest Bat (*Vespadelus vulturnus*). The acoustic survey also recorded Little Bent-winged Bat (*Miniopterus australis*) and Large Bent-winged Bat (*Miniopterus orianae oceanensis*).

Based on the acoustic results, additional harp trapping and habitat searches were undertaken (Table 5.13, Figure 5.2). Habitat searches within the study area used topographic mapping to focus on the steepest areas, in order to find rocky structures with potential roosting or breeding habitat. While there are some rocky areas, these did not contain crevices, caves or overhangs that would be utilised by either of these species. No evidence of use by bats was detected.

Harp trapping was carried out over four consecutive nights in January 2024. The dense vegetation and lack of tracks within the site made it difficult to target flyways for microbats. Suitable flyways were targeted where possible, but traps were also placed along the side of Reeves Street, and along the one track that cuts through the study area. Some traps were placed outside the study area to target the best habitat (along the track) but are not included in the calculation of effort to meet the guidelines.

The credentials and experience level of the surveyors and the weather conditions during surveys can be found in Appendix B.

Table 5.13 Microbat survey guidelines and effort

Target species	Recommended survey technique	Survey effort
Acoustic detection • Large-eared Pied Bat • Eastern Cave Bat	DPIE (2021) requires acoustic detection in four locations for a period of at least four nights, for every 50 ha of suitable habitat.	Four Anabats were deployed for four nights in November 2023. Calls were analysed by Amy Rowles using Anabat Insight.
Habitat assessment • Large-eared Pied Bat • Eastern Cave Bat	All potential roost structures must be searched within 100 m of the study area to identify breeding habitat, and within 2 km to define the species polygon (DPIE 2021).	Umwelt surveyed potential habitat within the footprint only. EMM conducted habitat searches on foot within an area 100 m from the subject land boundary. Land access did not allow for habitat within 2 km to be searched, so potential habitat was identified using LiDAR and topographic data.
Harp trapping • Large-eared Pied Bat • Eastern Cave Bat	DPIE (2021) requires harp trapping completed over four nights in four locations, for every 50 ha of suitable habitat.	EMM completed a total of 18 trap nights, setting five traps over four consecutive nights in January 2024.

d Diurnal birds

Targeted surveys were conducted for the following candidate species:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*, breeding)
- Eastern Bristlebird (*Dasyornis brachypterus*)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*, breeding)
- Little Eagle (*Hieraaetus morphnoides*, breeding)
- Square-tailed Kite (*Lophoictinia isura*, breeding)
- Eastern Ground Parrot (*Pezoporus wallicus wallicus*)
- Red-backed Button-quail (*Turnix maculosus*).

Umwelt conducted habitat assessments in a previous iteration of the footprint in March and May 2019 and March 2020, and EMM surveyed the remainder of the current footprint (study area) in October 2023 (Table 5.14, Figure 5.3).

Habitat assessment was undertaken across the subject land for suitable diurnal bird habitat values, including hollow bearing trees and stick nests. These features were also recorded incidentally throughout all diurnal surveys. During habitat assessment, all suitable hollow bearing trees and nests were recorded. Searches for diurnal birds were conducted concurrently with habitat assessment.

South-eastern Glossy Black-Cockatoos (previously a candidate species) and Gang-gang Cockatoos require tree hollows as breeding habitat. No suitable breeding hollows were recorded for South-eastern Glossy Black-Cockatoo during habitat assessment surveys, as this species generally prefers hollows that are more than 8 m off the ground. The species was recorded flying over the study area in February 2024, but was not displaying any breeding behaviours. The species was subsequently excluded from further candidate species assessment based on the lack of suitable breeding hollows (see Table 5.3), but will still generate ecosystem credits.

Gang-gang Cockatoos are usually found in tall mountain forests during their breeding season, so the site does not contain suitable breeding habitat for the species despite containing hollows of a suitable size. The species was not observed on site during surveys at any time.

No stick nests were recorded on the site (breeding habitat for raptors) during habitat assessments, so no further targeted surveys were conducted for raptor species (White-bellied Sea-Eagle, Little Eagle, Square-tailed Kite).

The remaining diurnal bird species were targeted through diurnal bird surveys at dawn in October 2023, using a combination of listening, call playback and area searches (Table 5.14).

Table 5.14 Diurnal bird survey guidelines and effort

Target species	Recommended survey technique	Survey effort
• Gang-gang Cockatoo • South-eastern Glossy Black-Cockatoo (subsequently excluded from candidate species list) • White-bellied Sea-Eagle • Little Eagle • Square-tailed Kite	Habitat assessment: Map all hollows of suitable size and identify potential raptor nests. Search for indirect evidence of nest/hollow use.	Umwelt (2020) completed habitat surveys in the previous iteration of the study area in August and October 2018. EMM surveyed the remainder of the study area for potential breeding habitat features, and covered the whole study area again during other survey techniques. Habitat surveys were conducted in October 2023, during the breeding season for Gang-gang Cockatoo, White-bellied Sea-Eagle, Little Eagle, and Square-tailed Kite.
• Eastern Bristlebird • Eastern Ground Parrot • Red-backed Button-quail • Gang-gang Cockatoo	Diurnal bird surveys: DEC (2004) recommends 20 minute area searches for diurnal birds but does not provide guidelines on survey effort. For the Eastern Bristlebird, DEWHA (2010) suggests area searches in suitable habitat in the early morning or dusk, listening for calls. Call playback can also be used to solicit responses. For area searches, a total of nine hours effort is required over three days. The TBDC suggests listening and call playback surveys at dawn for the Eastern Ground Parrot. Guidelines for the Western Ground Parrot (DEWHA 2010) suggest point surveys in suitable habitat, about 400 m apart, before sunrise and after sunset to detect distinctive calls. Surveys should be repeated over four days, with a total of 12 hours effort for areas of habitat up to 50 ha. Broadcast playback surveys can also be used with a total of six hours effort over three days.	Area searches, point surveys and call playback surveys were conducted early in the morning at four locations within the site, over four days in October 2023. At each survey location, surveys consisted of point surveys listening for calls, followed by call playback, then area searches for target species. At least 45 minutes was spent at each survey location, and the process was repeated over four days. Diurnal birds were also recorded incidentally during all other survey efforts.

Target species	Recommended survey technique	Survey effort
• White-bellied Sea-Eagle • Little Eagle • Square-tailed Kite	Nest checks during breeding season: The Threatened Biodiversity Data Collection (DPIE 2020b) states that each potential nest must be observed for signs of breeding (male and female, or adult with nesting material, any individual on the nest). No guidelines are provided on effort.	Habitat surveys were conducted in October 2023, during the breeding season for White-bellied Sea-Eagle, Little Eagle, and Square-tailed Kite. No stick nests were identified on the site during habitat assessments, so no further nest checks were required. None of the species were observed in the study area.
• Gang-gang Cockatoo	Stagwatching during breeding season: DPIE (2020b) requires surveys for signs of breeding, including begging birds, lone adult males or an occupied nest. Potential nest trees must be observed for signs of breeding (no guidance on effort).	Diurnal surveys were conducted during the breeding season (October 2023) for Gang-gang Cockatoos (habitat assessments, diurnal bird surveys, as well as targeted flora surveys and giant dragonfly surveys) and the species was not recorded in the study area. Although some hollows of suitable size were recorded in the study area, further targeted breeding surveys were not conducted given the species was not detected on site.
• Red-backed Button-quail	Flushing surveys: The DPIE (2020b) suggests nocturnal surveys for the Red-backed Button-quail, to flush birds from habitat. No guidelines on survey effort are available.	Diurnal surveys for this species were conducted in combination with other targeted surveys (Umwelt 2020). Flushing surveys were also conducted by EMM as part of spotlighting surveys. A total of 930 minutes (15.5 hours) of spotlighting was completed over five nights in January and February 2024, by teams of two people. This is a total of 31 person hours. If present, it is likely that this species would have been flushed during any of the diurnal or nocturnal surveys completed in the study area.

e Nocturnal birds

Targeted surveys were conducted for the following candidate species:

- Bush Stone-curlew (*Burhinus grallarius*)
- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*).

Umwelt conducted targeted surveys for nocturnal birds in the previous footprint, including:

- habitat assessment survey for breeding hollows (recorded one hollow that was suitable for owl breeding)
- stag watching survey for one hollow in May 2019
- spotlighting surveys over six nights in March and May 2019
- call playback in August 2018 and May 2019.

EMM resurveyed the study area for habitat features and identified 7 hollows with potential for use as owl habitat (>20 cm and >4m off the ground), although no hollows showed any evidence of use by owls. New owl survey guidelines were introduced in March 2024 (DPIE 2020b), taking the focus of surveys off hollows and focusing instead on call playback. EMM completed an additional three nights of call playback according to the methods outlined in these guidelines (Table 5.15, Figure 5.3).

EMM also completed spotlighting surveys in January and February 2024 as outlined in other sections.

Table 5.15 Nocturnal bird survey guidelines and effort

Target species	Recommended survey technique	Survey effort
• Barking Owl • Powerful Owl • Masked Owl	Habitat assessment: Map all hollows of suitable size for each owl species.	Umwelt (2020) completed hollow surveys in the previous footprint. EMM surveyed the remainder of the footprint for potential hollows, and additionally recorded hollows incidentally throughout other surveys.
• Barking Owl • Powerful Owl • Masked Owl	Call playback: DPIE (2020b) requires call playback to be conducted at one central location on sites less than 100 ha. Call playback to be conducted around dusk during calm conditions, and involves: • 10 minutes listening • broadcast calls for 15 seconds, followed by 30 seconds of listening time • repeat sequence for 15 minutes for each target species or until species is detected. One call playback site is required for the study area (<100 ha), repeated over six nights.	Umwelt (2020) completed two nights of call playback in August 2018 and three nights of call playback surveys in May 2019 at multiple locations across the site. EMM completed an additional three nights of call playback surveys in March and April 2024. In total, eight nights of call playback have been completed in the study area. Weather conditions during the survey period are provided in Appendix B.
• Bush Stone-curlew Incidental: • Barking Owl • Powerful Owl • Masked Owl	Spotlighting: DEC (2004) recommends spotlighting for this species but does not specify survey effort.	Spotlighting for this species was combined with the spotlighting effort for arboreal and terrestrial mammals. A total of 930 minutes (15.5 hours) of spotlighting was completed by EMM over five nights in January and February 2024, by teams of two people. This is a total of 31 person hours. The total length of the spotlighting tracks was 14.9 km, with the team surveying between 1.5 and 3.7 km per night.

f Amphibians

Targeted surveys were conducted for the following species:

- Giant Burrowing Frog (*Heleioporus australiacus*)
- Red-crowned Toadlet (*Pseudophryne australis*).

Umwelt completed targeted searches and spotlighting in March and May 2019 and March 2020, as well as call playback in March 2019. Red-crowned Toadlet was recorded in the study area in March and May 2019, and Giant Burrowing Frog was recorded in March 2020.

Given the lack of permanent drainage lines or creeklines in the study area, amphibian survey effort was initially combined with spotlighting surveys, and surveyors conducted call playback when spotlighting transects passed through or near to suitable frog habitat (Table 5.16, Figure 5.4).

EMM recorded both target species during nocturnal spotlighting surveys in January and February 2024. As such, no additional targeted survey was completed for these species as no further information was required to define a species polygon.

The credentials and experience level of the surveyors and the weather conditions during surveys can be found in Appendix B.

Table 5.16 Amphibian survey guidelines and effort

Target species	Recommended survey technique	Survey effort
Giant Burrowing Frog Red-crowned Toadlet	DPIE (2020) calculates survey effort based on extent of suitable breeding habitat (calculated per 1 km of breeding habitat). • Giant Burrowing Frog: ephemeral flowing streams with permanent pools, or in upland swamps. 960 minutes (over eight nights) of aural visual surveys. • Red-crowned Toadlet: 480 mins (four repeats) per 500 m suitable habitat. Call playback using loud sounds that males respond to can be completed after rainfall.	There is approximately 1.2 km of breeding habitat for the Giant Burrowing Frog (Fountain Creek is within 300 m but is outside the study area), as well as upland swamps. Ephemeral streams and pools within sandstone and upland swamp constitute potential breeding habitat for the Red-crowned Toadlet. Umwelt (2020) completed 10 nights of targeted surveys for these species, and three nights of call playback. They recorded both species in the study area. EMM conducted spotlighting surveys and recorded both species again during these surveys. A total of 930 minutes (15.5 hours) of spotlighting was completed by EMM over five nights in January and February 2024, by teams of two people. This is a total of 31 person hours. The total length of the spotlighting tracks was 14.9 km, with the team surveying between 1.5 and 3.7 km per night.

g Reptiles

Targeted surveys were conducted for the following species:

- Broad-headed Snake (*Hoplocephalus bungaroides*)

Umwelt conducted habitat surveys for this species in August 2018, as well as opportunistic observations during other survey methods.

EMM conducted habitat assessments and did not identify any suitable habitat such as rocks on rock substrates, sandstone outcrops, or crevices in rocky areas. All potential rocky habitat was checked as it was encountered (Table 5.17). Although there is no suitable rocky habitat within the subject land for the species to use during autumn, winter and spring, there is some possibility that the species would use the habitat on site during the summer months. During this period the species moves into crevices or tree hollows within 500 m of escarpments (DPIE 2020b).

EMM conducted spotlighting surveys for this species in January and February 2024, in combination with spotlighting surveys for other target species (Table 5.17, Figure 5.4). Spotlighting surveys generally consisted of traversing the length of the study area (approximately 1,200 m). Given the dense vegetation within the site, additional spotlighting effort was undertaken along Reeves St and along the access track within the study area, which allowed surveyors to move more quietly to detect animals.

Spotlighting surveys were completed on foot by a team of two ecologists surveying opposite sides of the transect, moving at a speed of approximately 10 m/min, using 750-1,000 lumen torches.

The credentials and experience level of the surveyors and the weather conditions during surveys can be found in Appendix B.

Table 5.17 Reptile survey guidelines and effort

Target species	Recommended survey technique	Survey effort
Habitat searches • Broad-headed Snake	DPE (2022e) requires habitat surveys in suitable habitat, involving: • turning over sun-exposed sandstone rocks lying on rock substrates • turning over logs and bark on rock substrates • inspecting crevices in outcrops using a torch. 120 minutes per 50 ha of habitat, repeated four times.	Umwelt (2020) completed two days of targeted searches for this species in August 2018 (combined with targeted flora surveys), as well as opportunistic observations throughout all other survey efforts. This site contains limited suitable rocky habitat. EMM also conducted habitat searches in October 2023 (out of season) and did not find any rocky habitat that is well suited to this species.
Spotlighting surveys • Broad-headed Snake	DPE (2022) requires 2 hours of spotlighting for every 50 ha of suitable habitat, repeated on 4 consecutive nights.	Umwelt completed eight nights of spotlighting surveys in May 2019 and March 2020, as well as spotlighting in 'Summer 2019' (Umwelt 2020). EMM completed spotlighting surveys over five nights in January and February 2024. A total of 930 minutes (15.5 hours) of spotlighting was completed by EMM, by teams of two people. This is a total of 31 person hours. Four consecutive nights of survey were completed in January, and one additional night in February. The total length of the spotlighting tracks was 14.9 km, with the team surveying between 1.5 and 3.7 km per night.

h Invertebrates

Targeted surveys were conducted for the following species:

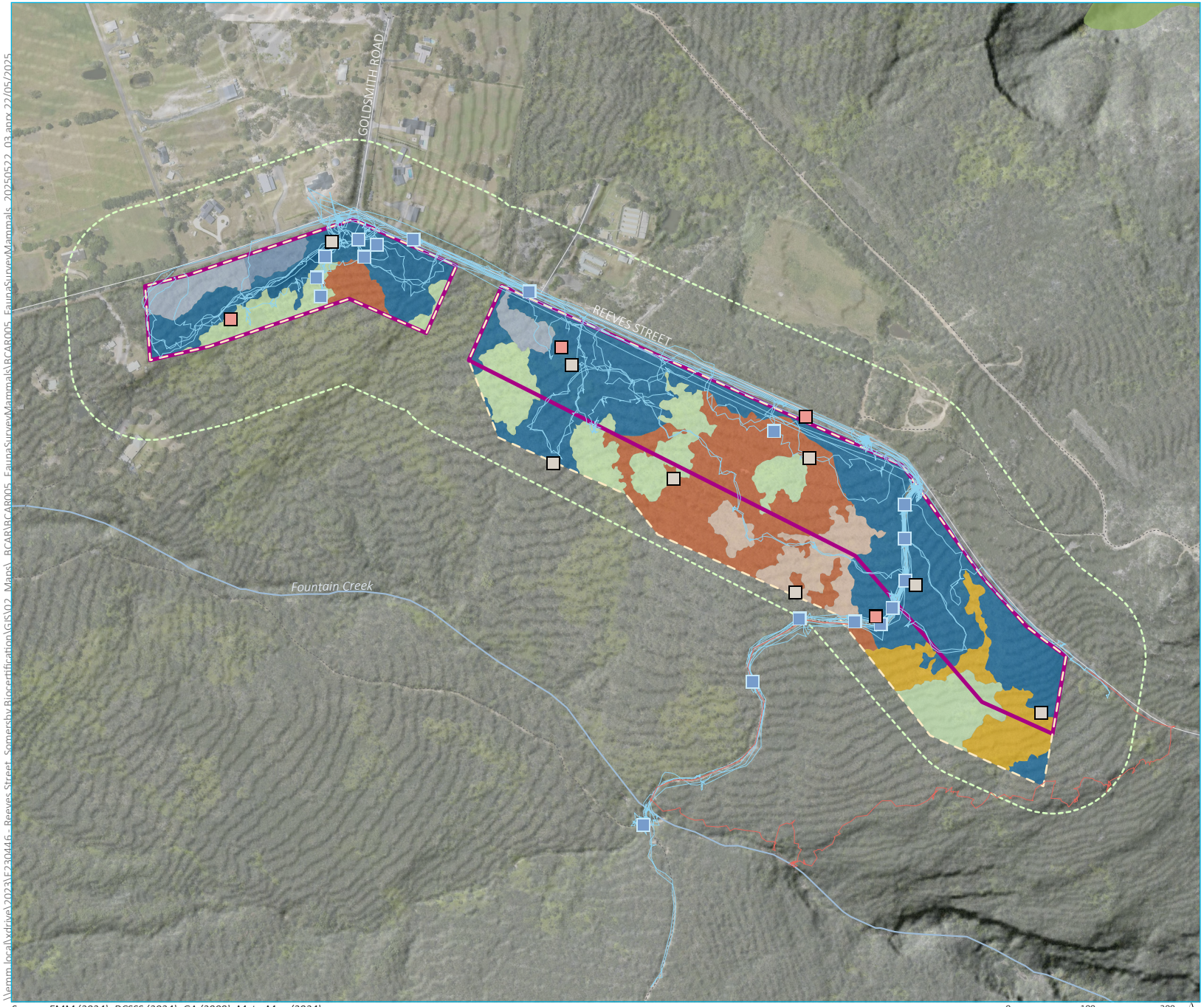
- Maroubra Woodland Snail
- Giant Dragonfly.

EMM surveyed for Maroubra Woodland Snail in conjunction with SAT searches for Koalas (Table 5.18, Figure 5.4). This allowed surveyors to search under leaf litter and debris while looking for koala scats.

Swamp habitats within the study area were surveyed for Giant Dragonfly by Umwelt in January 2019, and by EMM in January 2024 (Table 5.18, Figure 5.4). EMM conducted transects in each patch of upland swamp habitat, focusing on the wetter patches in the west of the study area. Surveyors searched for casings left behind by the dragonflies, as well as the dragonflies themselves.

Table 5.18 Invertebrate survey guidelines and effort

Target species	Recommended survey technique	Survey effort
• Maroubra Woodland Snail	Habitat searches: No survey effort is outlined in the DPIE (2020b). Habitat under leaf litter and debris should be searched for shells or live snails. Live specimens can only be detected when the top layer of soil is moist, during or after rain.	Surveyed during Koala SAT surveys, where leaf litter was scraped back. EMM completed eight SAT surveys across the study area in October 2023 and March 2024. Extensive searches under 30 trees at eight locations through the study area. In total, leaf litter was searched under 240 trees within the study area.
• Giant Dragonfly	Habitat searches: No survey effort is outlined in the DPIE (2020b). Swamp habitat should be surveyed for adult dragonflies and casings left behind by moulting pupae.	Umwelt (2020) completed targeted searches within and adjacent to suitable swamp habitat, over two days. EMM carried out two days of targeted searches for this species in swamp habitat within the study area in January 2024. A total of seven hours of transects were completed by a team of two people, equating to 13.5 person hours.



KEY

Subject land
Study area

Existing environment

Minor road
Vehicular track
Named watercourse
State forest

Mammal survey effort

SAT location
Harp trap location
Anabat location
Bat roost habitat search
Spotlighting track
100m buffer for microbat habitat assessment

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland
High
Open

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest
High
Disturbed
Pines

PCT 3807 | Northern Sydney Heath-Mallee
High

PCT 3924 | Sydney Coastal Upland Swamp Heath
High

Source: EMM (2024); DCSSS (2024); GA (2009); MetroMap (2024)

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GDA2020 MGA Zone 56
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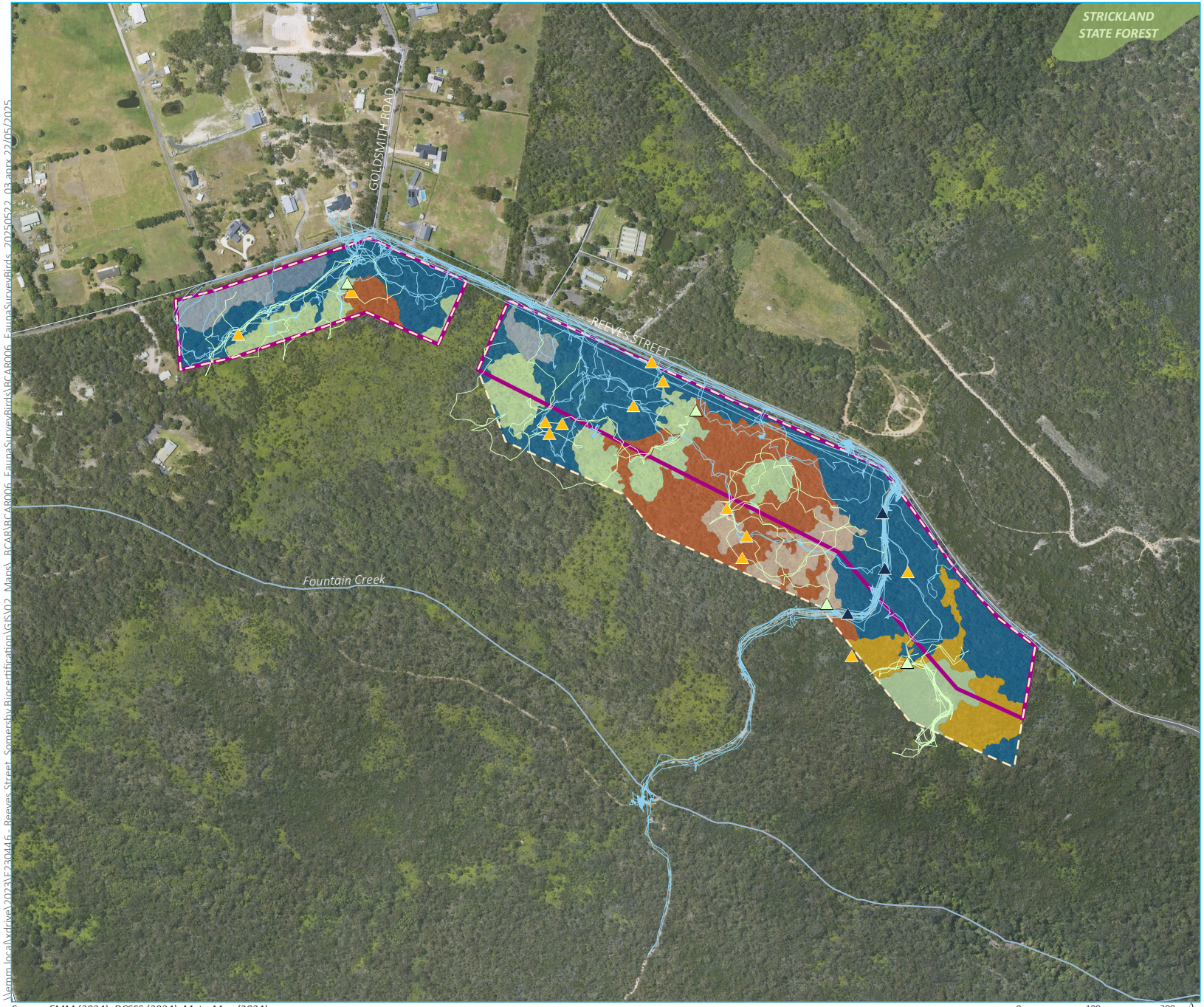
Fauna survey effort: mammals

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 5.2

EMM
creating opportunities



KEY

Subject land
Study area

Existing environment

Major road
Minor road
Vehicular track
Named watercourse
State forest

Bird survey effort

Call playback location
Hollow bearing tree
Diurnal bird survey location
Spotlighting track
Diurnal bird survey area search

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland
High
Open

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest
High
Disturbed
Pines

PCT 3807 | Northern Sydney Heath-Mallee
High

PCT 3924 | Sydney Coastal Upland Swamp Heath
High

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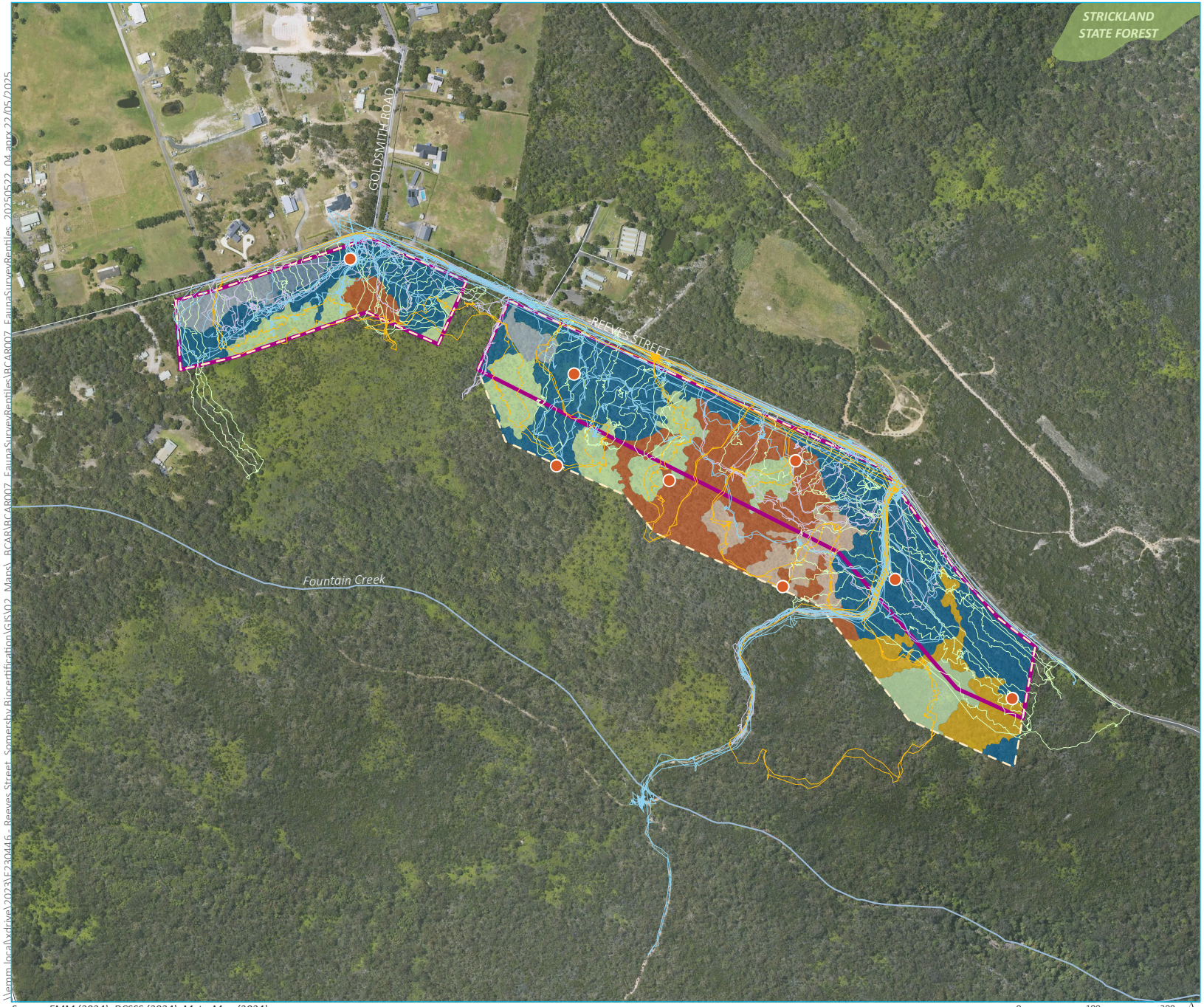
Source: EMM (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m
GDA2020 MGA Zone 56
N

Fauna survey effort: birds

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 5.3

EMM
creating opportunities



KEY

- Subject land
- Study area

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- State forest

Frogs, reptiles, and invertebrates survey effort

- Snail search
- Giant dragonfly track
- Spotlighting track
- Umwelt frog survey track
- Umwelt reptile habitat search

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland

- High
- Open

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest

- High
- Disturbed
- Pines

PCT 3807 | Northern Sydney Heath-Mallee

- High

PCT 3924 | Sydney Coastal Upland Swamp Heath

- High

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Source: EMM (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m

GDA2020 MGA Zone 56

N

Fauna survey effort: frogs, reptiles and invertebrates

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 5.4

EMM
creating opportunities

5.4.4 Presence of candidate species

In total, seven candidate species were recorded within the subject land, including two flora species (Figure 5.5) and five fauna species (Figure 5.6):

- Spreading Guinea Flower (*Hibbertia procumbens*)
- *Hibbertia puberula*
- Eastern Pygmy-possum (*Cercartetus nanus*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Giant Burrowing Frog (*Heleioporus australiacus*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Red-crowned Toadlet (*Pseudophryne australis*).

Results are summarised below, and the extent of the species polygons for each species present are outlined in Section 5.4.5.

i Threatened flora

Spreading Guinea Flower has been recorded throughout the site, in all PCTs with which it is associated (PCTs 3586, 3593, and 3924). The species was recorded by Umwelt during surveys in 2018 and 2019 at four locations within the study area, then again by EMM during surveys in February 2024, at 71 locations throughout the study area.

Hibbertia puberula was recorded in PCT 3593 during February 2024 surveys, in three locations near the walking track that cuts through the study area. This species is only associated with PCT 3593.

Somersby Mintbush was recorded within the study area in PCT 3586 during November and February surveys. The species was recorded in a cluster near the southern boundary of the study area (Figure 5.5). This species had not previously been recorded within the study area but was known to occur in the broader site. The subject land has since been redesigned such that there are no records of Somersby Mintbush within the subject land. The species does not require a species polygon and will not generate species credits.

ii Threatened fauna

a Arboreal mammals

A Squirrel Glider was recorded by Umwelt in March 2020, during spotlighting surveys. Although this species can be difficult to distinguish from similar species such as the Sugar Glider (*Petaurus breviceps*), the Umwelt team reached a consensus both in the field and with their wider team based on photographs taken, that the individual was a Squirrel Glider (Umwelt 2020). There are numerous existing records of this species in the region.

The Eastern Pygmy-possum was recorded during spotlighting surveys in January 2024. Although this species is usually difficult to detect using this survey methodology, an individual was sighted in the canopy of a eucalypt near the roadside. Surveyors got a clear view and watched the individual for approximately 20 minutes to confirm. This species had previously been assumed to be present in the study area (Umwelt 2020), based on existing records, suitable habitat, and the difficulty of detection.

Other mammals recorded by EMM during spotlighting surveys included Sugar Glider (*Petaurus breviceps*) and Common Ringtail Possum (*Pseudocheirus peregrinus*).

No koalas, or evidence of koalas, were detected during surveys.

b Terrestrial mammals

No target terrestrial mammal species were recorded during surveys.

c Microchiropteran bats

Acoustic surveys for microbats recorded eleven different species, including Large-eared Pied Bat, as well as calls that could be either from Eastern Cave Bat (*Vespadelus troughtoni*) or Little Forest Bat (*Vespadelus vulturnus*). The acoustic survey also recorded Little Bent-winged Bat (*Miniopterus australis*) and Large Bent-winged Bat (*Miniopterus orianae oceanensis*).

Harp trapping surveys did not record either of the target species, however several Little Forest Bats were captured at various locations across the study area, suggesting that the calls detected in acoustic surveys were from this species, and not from the Eastern Cave Bat.

Other species captured during harp trapping surveys included Gould's long-eared bat (*Nyctophilus gouldi*) and Lesser Long-eared Bat (*Nyctophilus geoffroyi*).

Based on the combined survey effort, the only target species recorded was Large-eared Pied Bat. Although the species was not detected in harp trapping surveys, the calls detected during acoustic surveys were analysed by experienced bat call analyst Amy Rowles, and it was deemed “definite” that the recorded calls were attributable to this species. Despite being detected in acoustic surveys (likely foraging) there is no suitable breeding habitat present for this species in the subject land.

d Diurnal birds

Glossy Black Cockatoos were recorded flying over the site but will not generate species credits due to lack of suitable breeding habitat or displays of breeding behaviour.

No other target diurnal bird species were recorded in the study area during surveys.

e Nocturnal birds

No target nocturnal bird species were recorded during surveys.

f Amphibians

Giant Burrowing Frog was recorded by Umwelt during surveys in March 2020. One individual was recorded inside the previous study area, and a further six recorded south of the study area boundary (Umwelt 2020). The species was recorded again incidentally by EMM during spotlighting surveys in January 2024, inside the subject land. All records of this species are situated along the access track, likely due to increased visibility, but the species is associated with all PCTs present in the subject land.

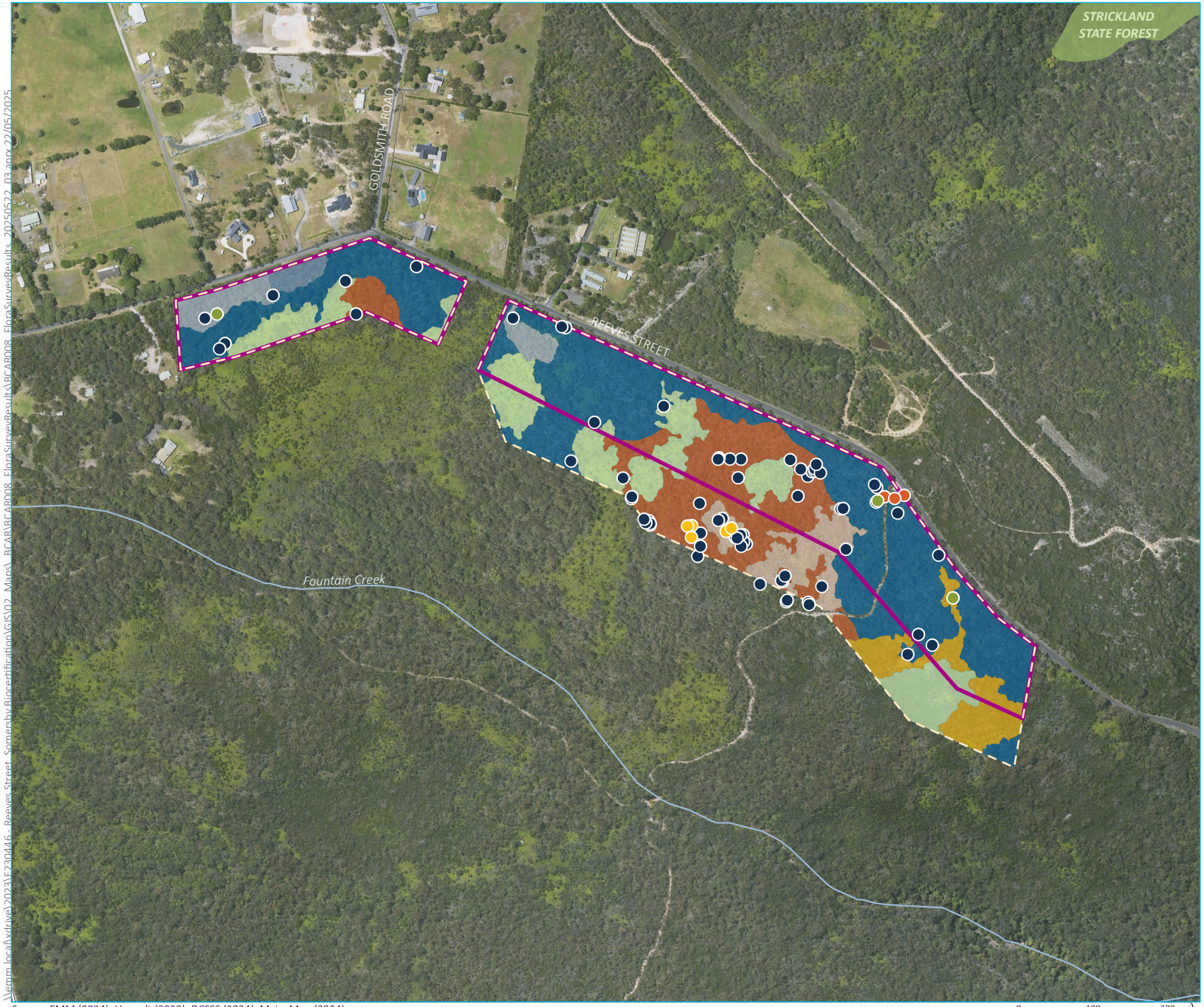
Red-crowned Toadlets have been recorded consistently within the site since 2019. The species was recorded by Umwelt in their surveys in March and May 2019 (Umwelt 2020), and was recorded repeatedly by EMM during surveys in 2023 and 2024. During most visits to the site by EMM in 2023 and 2024, the species was heard calling from an artificial drainage line next to the access track. The species was also heard calling from areas of upland swamp during nocturnal surveys, and is associated with all the PCTs present in the subject land.

g Reptiles

No target reptile species were recorded during surveys.

h Invertebrates

No target invertebrate species were recorded during the surveys.



KEY

Subject land

Study area

Existing environment

Major road

Minor road

Vehicular track

Named watercourse

State forest

Species records

Umwelt (2020)

Hibbertia procumbens

EMM

Hibbertia procumbens

Hibbertia puberula

Prostanthera junonis

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland

High

Open

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest

High

Disturbed

Pines

PCT 3807 | Northern Sydney Heath-Mallee

High

PCT 3924 | Sydney Coastal Upland Swamp Heath

High

State forest

Source: EMM (2024); Umwelt (2020); DCSSS (2024); MetroMap (2024)

0 100 200 m

GDA2020 MGA Zone 56

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Flora survey results

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Reeves Street, Somersby
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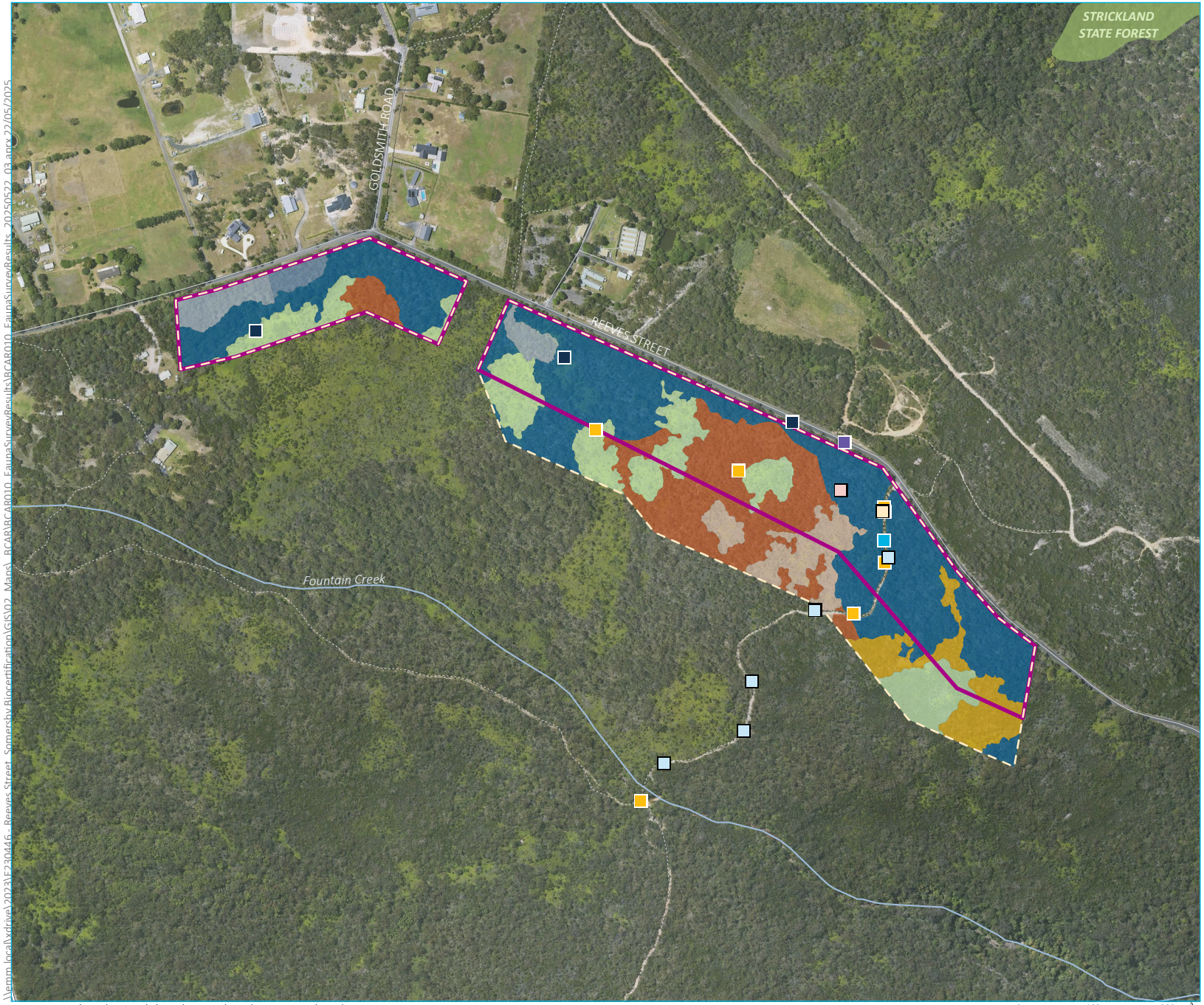
Figure 5.5

EMM
creating opportunities



KEY

Subject land

Study area

Existing environment

Major road

Minor road

Vehicular track

Named watercourse

State forest

Species records

Umwelt (2020)

Giant Burrowing Frog

Red-crowned Toadlet

Squirrel Glider

EMM

Large-eared Pied Bat

Eastern Pygmy-possum

Giant Burrowing Frog

Red-crowned Toadlet

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland

High

Open

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest

High

Disturbed

Pines

PCT 3807 | Northern Sydney Heath-Mallee

High

PCT 3924 | Sydney Coastal Upland Swamp Heath

High

Source: EMM (2024); Umwelt (2020); DCSSS (2024); MetroMap (2024)

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GDA2020 MGA Zone 56

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Fauna survey results

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Biodiversity Certification Assessment Report
Figure 5.6

EMM
creating opportunities

5.4.5 Species polygons

i Eastern Pygmy-possum

Eastern Pygmy-possum (*Cercartetus nanus*) is assessed using an area unit of measure. There are no specific instructions provided by DPIE on how to draw a species polygon for this species. One individual was recorded in an area of PCT 3593. Given that the species is associated with all PCTs present within the subject land, as defined in the TBDC (DPIE 2020b), and that suitable habitat is present throughout all vegetation zones, the entirety of the subject land has been included in the species polygon.

A summary of the habitat condition within the species polygon for the Eastern Pygmy-possum is provided in Table 5.19, with the polygon displayed in Figure 5.7.

Table 5.19 Habitat condition within the species polygon for Eastern Pygmy-possum

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3586 – High	63.9	2.09
PCT 3586 – Open	65.6	0.27
PCT 3593 – High	75.9	7.68
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
PCT 3807 – High	95.9	0.43
PCT 3924 - High	12.4	1.83
Total	-	13.33

ii Large-eared Pied Bat

Large-eared Pied Bat (*Chalinolobus dwyeri*) is assessed using an area unit of measure. The species polygon should include all habitat that lies within 2 km of potential roost habitat (including caves, scarps, cliffs, rock overhangs and disused mines) (DPIE 2021). There is steep terrain to the east of the subject land, an escarpment that extends north and south on the eastern edge of the Somersby Plateau. This area contains potential roost habitat for the species in the cliffs and overhangs.

The closest potential roost habitat for the species is approximately 250 m from the boundary of the subject land, where Fountain Creek becomes a gorge (see Figure 5.8). This habitat lies within 2 km of the entirety of the subject land. As such, all areas of PCTs with which the species is associated, as defined in the TBDC (DPIE 2020b), have been included in the species polygon (PCTs 3586, 3593, and 3924).

A summary of the habitat condition within the species polygon for the Large-eared Pied Bat is provided in Table 5.20, with the polygon displayed in Figure 5.8.

Table 5.20 Habitat condition within the species polygon for Large-eared Pied Bat

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3586 – High	63.9	2.09
PCT 3586 – Open	65.6	0.27
PCT 3593 – High	75.9	7.68

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
PCT 3924 - High	12.4	1.83
Total	-	12.89

iii Giant Burrowing Frog

Giant Burrowing Frog (*Heleioporus australiacus*) is assessed using an area unit of measure. The DPIE guidelines state (DPIE 2020d):

> The species polygon boundary should align with suitable aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 300 metres radius from the top of bank.

Along with suitable flowing streams, upland swamps are listed as breeding habitat in the survey guidelines (DPIE 2020d), and non-breeding habitat is native vegetation adjacent to breeding sites.

The subject land comprises a matrix of upland swamp patches and woodland habitat. Each mapped area of upland swamp is separated by a distance of less than 100 m, or would be part of a continuous swamp outside of the subject land boundary. All records of Giant Burrowing Frog were made along the access track that cuts through the subject land, approximately 150 m from surrounding areas of upland swamp habitat, and in the largest gap between patches of upland swamp. It is assumed that Giant Burrowing Frogs could be using all areas of swamp within the subject land as breeding habitat, given that all patches are either directly linked or are in close proximity.

The species polygon (Figure 5.7) was drawn by adding a 300 m buffer to the boundaries of all upland swamp patches. Giant Burrowing Frog is associated with all of the PCTs mapped in the subject land, as defined in the TBDC. After buffers were applied, the entirety of the subject land was included in the species polygon. Table 5.21 summarises the habitat condition within the species polygon for the Giant Burrowing Frog.

Table 5.21 Habitat condition within the species polygon for Giant Burrowing Frog

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3586 – High	63.9	2.09
PCT 3586 – Open	65.6	0.27
PCT 3593 – High	75.9	7.68
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
PCT 3807 – High	95.9	0.43
PCT 3924 - High	12.4	1.83
Total	-	13.33

iv Spreading Guinea Flower

Spreading Guinea Flower (*Hibbertia procumbens*) is assessed using an area unit of measure. There are no specific instructions in the TBDC (DPIE 2020b) for drawing a species polygon for this species.

The species has been recorded at 71 locations throughout the study area, in all vegetation zones, and is associated with three of the four PCTs present in the subject land (PCTs 3586, 3593, and 3924), as defined in the TBDC (DPIE 2020b).

Although the species is not associated with PCT 3807, it was recorded within this PCT and this PCT has therefore been included in the species polygon.

Figure 5.7 shows the records of this species and the species polygon. A summary of the habitat condition within the species polygon for the Spreading Guinea Flower is provided in Table 5.22.

Table 5.22 Habitat condition within the species polygon for Spreading Guinea Flower

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3586 – High	63.9	2.09
PCT 3586 – Open	65.6	0.27
PCT 3593 – High	75.9	7.68
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
PCT 3807 – High	95.9	0.43
PCT 3924 - High	12.4	1.83
Total	-	13.33

v *Hibbertia puberula*

Hibbertia puberula is assessed using an area unit of measure. There are no specific instructions in the TBDC for drawing a species polygon for this species. Of the PCTs present in the subject land, the species is associated with PCT 3593 only, as defined in the TBDC. Three individuals were recorded in one patch in the subject land, in PCT 3593, in a disturbed area near the access track. Given that the species was recorded in a disturbed area, the Disturbed and Pines vegetation zones of PCT 3593 have been included in the species polygon.

Figure 5.9 shows the records of this species, and the species polygon. A summary of the habitat condition within the species polygon for the Spreading Guinea Flower is provided in Table 5.23.

Table 5.23 Habitat condition within the species polygon for *Hibbertia puberula*

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3593 – High	75.9	7.68
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
Total	-	8.70

vi Squirrel Glider

Squirrel Glider (*Petaurus norfolcensis*) is assessed using an area unit of measure. There are no specific guidelines in the TBDC (DPIE 2020b) for drawing a species polygon. The species is associated with all PCTs present in the subject land, as defined in the TBDC, and was recorded in an area of woodland in PCT 3593. There is suitable habitat for this species throughout the subject land. Even in areas of upland swamp where there is no tree canopy, there are emergent Banksias and other flowering species that would provide a foraging resource for the species. As such, all vegetation zones have been included in the species polygon.

Figure 5.7 shows the species polygon for the Squirrel Glider, and Table 5.24 summarises the habitat condition within the species polygon.

Table 5.24 Habitat condition within the species polygon for Squirrel Glider

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3586 – High	63.9	2.09
PCT 3586 – Open	65.6	0.27
PCT 3593 – High	75.9	7.68
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
PCT 3807 – High	95.9	0.43
PCT 3924 – High	12.4	1.83
Total	-	13.33

vii Red-crowned Toadlet

Red-crowned Toadlet (*Pseudophryne australis*) is assessed using an area unit of measure. The DPIE guidelines for the Red-crowned Toadlet species polygon state (DPIE 2020d):

> The species polygon boundary should align with aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 100 metres radius from the top of bank.

This species inhabits periodically wet drainage lines, sheltering in dense vegetation and leaf litter, and uses ephemeral pools and streams as breeding habitat, laying their eggs in moist leaf litter.

Relevant aquatic habitats within the subject land include areas of upland swamp, and the various pools along the access track. The species was recorded calling from both of these locations.

The subject land comprises a matrix of upland swamp patches and woodland habitat. Each mapped area of upland swamp is separated by a distance of less than 100 m, or would be part of a continuous swamp outside of the subject land boundary. It was assumed that Red-crowned Toadlets could be using all areas of swamp within the subject land as breeding habitat.

The Red-crowned Toadlet is associated with all the PCTs mapped in the subject land, as defined in the TBDC (DPIE 2020b). The species polygon for this species was drawn by adding a 100 m buffer onto areas of upland swamp, as well as a 100 m buffer onto the access track, along which they were repeatedly recorded.

The species polygon for Red-crowned Toadlet is shown in Figure 5.7, and a summary of the habitat condition within the species polygon is provided in Table 5.25.

Using the principles outlined above, there was 0.02 ha of the subject land not included in the species polygon. The whole subject land has conservatively been included in the species polygon.

Table 5.25 Habitat condition within the species polygon for Red-crowned Toadlet

Vegetation zone included in polygon	Vegetation integrity score	Area within species polygon (ha)
PCT 3586 – High	63.9	2.09
PCT 3586 – Open	65.6	0.27
PCT 3593 – High	75.9	7.68
PCT 3593 – Disturbed	40.8	0.24
PCT 3593 – Pines	48.8	0.77
PCT 3807 – High	95.9	0.43
PCT 3924 - High	12.4	1.83
Total	-	13.33

KEY

Subject land

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- State forest

Species records

- Eastern Pygmy-possum
- Spreading Guinea Flower
- Giant Burrowing Frog
- Red-crowned Toadlet
- Squirrel Glider

Species polygon

- Eastern Pygmy-possum, Giant Burrowing Frog, Spreading Guinea Flower, Squirrel Glider, Red-crowned Toadlet

Source: EMM (2024); Umwelt (2020); DCSSS (2024); MetroMap (2024)

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Species polygon for Eastern Pygmy-possum, Giant Burrowing Frog, Spreading Guinea Flower, Squirrel Glider, Red-crowned Toadlet

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Figure 5.7

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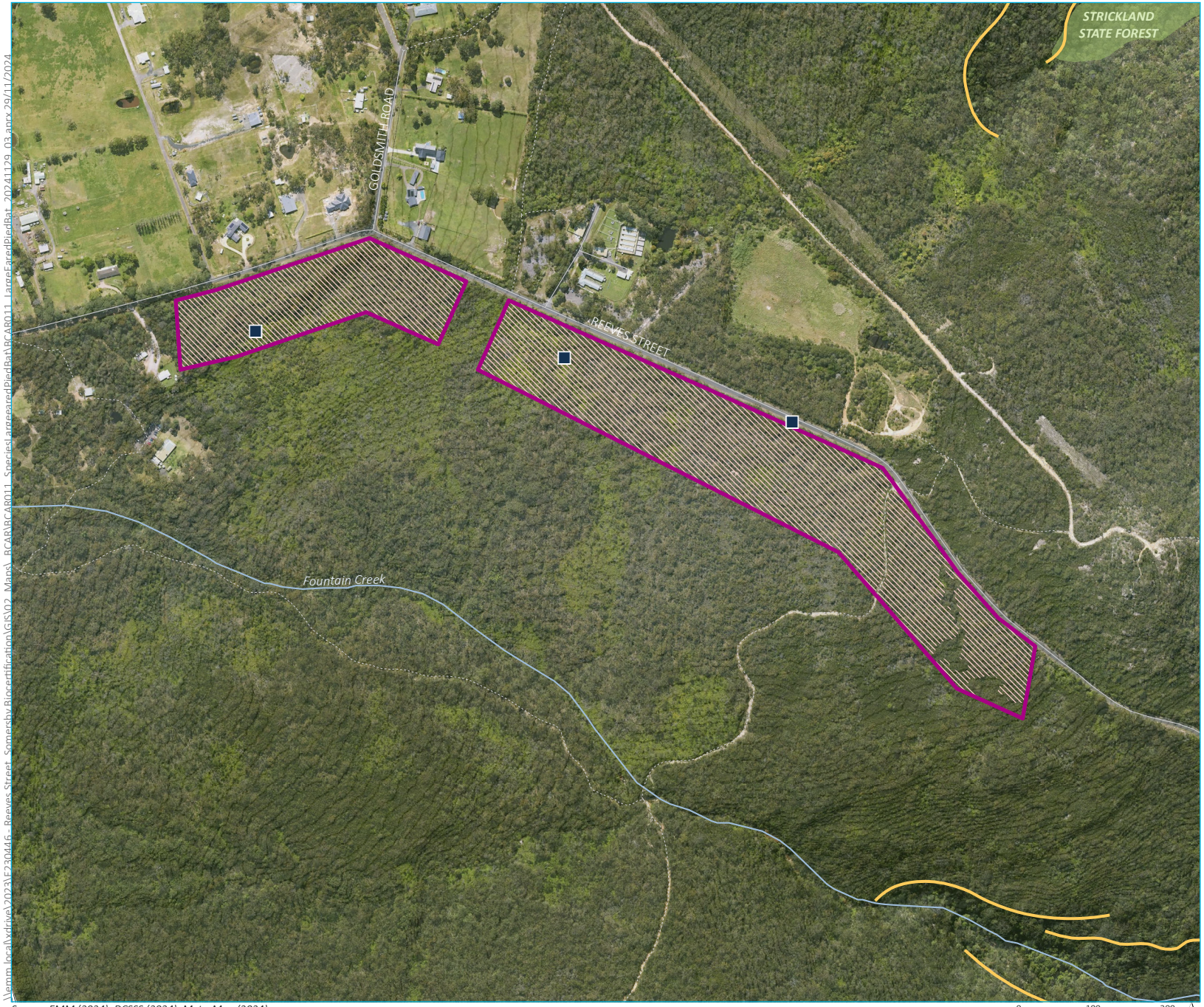

KEY

- Subject land
- Cliffline (potential roost habitat)

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- State forest

Species records

- Large-eared Pied Bat

Species polygon

- Large-eared Pied Bat

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Source: EMM (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m

GDA2020 MGA Zone 56

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Large-eared Pied Bat
species polygon

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Figure 5.8

EMM
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KEY

- Subject land

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- State forest

Species records

- *Hibbertia puberula*

Species polygon

- *Hibbertia puberula*

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Source: EMM (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m

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N

Hibbertia puberula
Species polygon

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Figure 5.9

EMM
creating opportunities

Stage 2 – Impact Assessment

6 Avoidance and minimisation

6.1 Avoidance and minimisation of impacts to biodiversity values

6.1.1 Introduction

Key biodiversity values within the subject land are as follows:

- Known habitat for:
    - Spreading Guinea Flower (*Hibbertia procumbens*), listed as endangered under the BC Act
    - *Hibbertia puberula*, listed as endangered under the BC Act
    - Eastern Pygmy-possum (*Cercartetus nanus*), listed as vulnerable under the BC Act
    - Large-eared Pied Bat (*Chalinolobus dwyeri*), listed as endangered under both the BC Act and EPBC Act and an SAII entity under the BAM
    - Giant Burrowing Frog (*Heleioporus australiacus*), listed as vulnerable under both the BC Act and EPBC Act
    - Squirrel Glider (*Petaurus norfolcensis*), listed as vulnerable under the BC Act
    - Red-crowned Toadlet (*Pseudophryne australis*), listed as vulnerable under the BC Act.
- Occurrence of the endangered ecological community, Coastal Upland Swamp in the Sydney Basin Bioregion; listed as endangered under the BC Act and EPBC Act. This community is also an SAII entity.
- Location in an area identified as a strategic biodiversity corridor between Ourimbah State Forest and Jilliby State Conservation Area in the north, and Brisbane Water National Park in the south (DPE 2022e).

Habitat for the species listed above is known to occur in the study area and is likely to occur in the wider biodiversity certification assessment area, outside of the subject land. Targeted survey efforts were focused on the study area only, however as the study area is highly connected to the remainder of the site through native vegetation, the entirety of the biodiversity certification assessment area is also likely to be habitat for these species.

The areas of Coastal Upland Swamp modelled outside the study area also indicate that the community occurs in the remainder of the biodiversity certification assessment area. These areas are located primarily in the northern half of the biodiversity certification assessment area in proximity to watercourses.

The occurrences of these species and community indicates that the biodiversity certification assessment area contains high connectivity and biodiversity value. These values have driven key avoidance and minimisation strategies within the biodiversity certification assessment area and subject land. The following sections expand on the avoidance and minimisation strategy that is applied to the proposed rezoning and future residential development.

6.1.2 Avoidance and minimisation – Design process

A number of technical assessments have been conducted within the site. These surveys have been carried out in parallel with, and have informed the evolution of, the design of the planning proposal (Figure 1.2). As part of consultation with Darkinjung LALC, planners and associated technical assessments, the original design of the planning proposal and subject land has been altered and located to avoid areas with higher biodiversity value (where possible).

The original iteration of the planning proposal (Umwelt 2020) included a larger area of impact. The area proposed for rezoning for residential living comprised the area of proposed residential lots, as well as a vegetated buffer zone. This area is shown as the 'Previous biocertification boundary - Umwelt 2020' in Figure 6.1, and is referred to within this chapter as the previous biocertification boundary (Umwelt). Although the vegetated buffer zone was outside of the previous study area assessed by Umwelt (2020), it was within the area to be rezoned for residential living, and therefore would likely have been susceptible to some level of impact to biodiversity values.

Darkinjung subsequently reduced the area to be rezoned for residential development (EMM 2023a), to the area shown in Figure 6.1 as the 'Study area (previous biocertification boundary - EMM 2023)'. This area comprises the current study area for this assessment, and is referred to within this chapter as the previous biocertification boundary (EMM).

Finally, the biocertification area has been further reduced to the footprint shown as the 'Subject land (current biocertification boundary)' in Figure 6.1. Additionally, in order to further reduce the impacts on the Coastal Upland Swamp, the firetrail has been relocated inside the area for residential development, and will be designed to minimise impacts to the retained areas of Coastal Upland Swamp within the subject land.

The key drivers of the avoidance measures taken throughout the design process were the presence of the Coastal Upland Swamp EEC within the site, the threatened species associated with this community, and the presence of Somersby Mintbush within the site.

The iterative design process, when the previous biocertification boundary (Umwelt) is compared to the subject land, has resulted in:

- a 56% reduction in the total area of native vegetation impacted compared to the previous biocertification boundary (Umwelt)
- an 80% reduction in impact to Coastal Upland Swamp EEC when compared to the previous biocertification boundary (Umwelt)
- a 46% reduction in impact to Coastal Upland Swamp EEC when compared to the previous biocertification boundary (EMM).

Table 6.1 Areas of vegetation avoided through design

	Previous biocertification boundary (Umwelt) (ha)	Previous biocertification boundary (EMM) (ha)	Subject land (ha)	Area avoided (ha)
Native vegetation	30.27	19.47	13.33	16.95
Coastal Upland Swamp EEC (BC Act and EPBC Act)	9.35	3.42	1.83	7.52

The previous biocertification boundary (Umwelt) comprised a much larger extent of native vegetation and Coastal Upland Swamp EEC. The extent of Coastal Upland Swamp EEC in the previous biocertification boundary (Umwelt) also comprised the largest patch of swamp within the biocertification area (Figure 6.1). Based on early field investigations, this patch supports larger areas of wetter, more unique sub-types of the upland swamps. The residual impacts of the proposed rezoning are to smaller patches of upland swamp which are more marginal.

EMM has completed more comprehensive mapping of the extent of Coastal Upland Swamp across the study area and has worked with Darkinjung and their designers to redesign the proposed subject land for the planning proposal. As outlined above, this has been a key driver for avoidance given the importance of this community. This process resulted in a drastically changed and modified layout and subject land, with shallower lots and a reduction in lot size.

The updated subject land avoids larger areas of native vegetation (16.95 ha) and excludes significant areas of Coastal Upland Swamp EEC, avoiding 7.52 ha of the EEC compared to the previous biocertification boundary (Umwelt), and maximises areas where the size of swamp patches is smaller (Figure 6.1).

By avoiding areas of Coastal Upland Swamp EEC, the subject land is also avoiding potential habitat for the many species supported by that community, and maintaining vegetated connections to offsite habitats (both within and outside of the biocertification area). The substantial contraction of the subject land and it's placement within the site enables the proposed development to:

- avoid 34 known records of Spreading Guinea Flower (*Hibbertia procumbens*) and 16.95 ha of habitat (reduction of 44% of individuals found and a reduction from 30.27 ha; refer to Figure 6.1)
- completely avoid known Somersby Mintbush (*Prostanthera junonis*) records and associated habitat and avoidance of impact to this SAII entity (refer to Figure 6.1)
- reduce the area of impact on Eastern Pygmy-possum (*Cercartetus nanus*), from 30.27 ha to 13.33 ha
- reduce the area of impact on foraging habitat for Large-eared Pied Bat (*Chalinolobus dwyeri*), from 28.99 ha to 12.89 ha and complete avoidance of potential breeding habitat (located on Fountain Creek)
- reduce the area of impact on Giant Burrowing Frog (*Heleioporus australiacus*) from 30.27 ha to 13.33 ha
- reduce the area of impact on Squirrel Glider (*Petaurus norfolcensis*), from 30.27 ha to 13.33 ha
- reduce the area of impact on Red-crowned Toadlet (*Pseudophryne australis*), from 30.27 ha to 13.33 ha.

The iterative design process has also focused on ensuring adequate protection for the biodiversity corridors:

- The planning proposal will rezone over 100 ha from RU2 (Rural Landscape) to C2 (Environmental Conservation). This will remove a number of permitted uses in the RU2 zone that would not be compatible with the biodiversity values of the site.

A summary of avoided and minimised impacts is presented in Table 6.2.

Table 6.2 Summary of avoided/minimised impacts

Biodiversity value	Previous biocertification boundary (Umwelt)	Previous biocertification boundary (EMM)	Subject land
Coastal Upland Swamp EEC	Impact is estimated to be approximately 9.35 ha.	Impact is reduced to approximately 3.42 ha.	Impact is further reduced to 1.83 ha.
Spreading Guinea Flower (*Hibbertia procumbens*)	Impact is estimated to be 78 known records and 30.27 ha of habitat.	Impact is estimated to be 70 known records and 19.47 ha of habitat.	Impact is estimated to be 34 known records and 13.33 ha of habitat.
Hibbertia puberula	Impact is estimated to be three known records and 13.19 ha of habitat.	Impact is estimated to be three known records and 9.91 ha of habitat.	Impact is estimated to be three known records and 8.70 ha of habitat.

Biodiversity value	Previous biocertification boundary (Umwelt)	Previous biocertification boundary (EMM)	Subject land
Somersby Mintbush (*Prostanthera junonis*)	Impact is estimated to be 29 known records	Impact remains unchanged	No impact to known records or habitat. Avoids impacting 29 known records
Eastern Pygmy-possum (*Cercartetus nanus*)	Impact is estimated to be approximately 30.27 ha of habitat.	Impact is reduced to approximately 19.47 ha of habitat.	Impact is further reduced to 13.33 ha of habitat.
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Impact is estimated to be approximately 28.99 ha of foraging habitat.	Impact is reduced to approximately 18.18 ha of foraging habitat.	Impact is further reduced to 12.89 ha of foraging habitat.
Giant Burrowing Frog (*Heleioporus australiacus*)	Impact is estimated to be approximately 30.27 ha of habitat.	Impact is reduced to approximately 19.47 ha of habitat.	Impact is further reduced to 13.33 ha of habitat.
Squirrel Glider (*Petaurus norfolcensis*)	Impact is estimated to be approximately 30.27 ha of habitat.	Impact is reduced to approximately 19.47 ha of habitat.	Impact is further reduced to 13.33 ha of habitat.
Red-crowned Toadlet (*Pseudophryne australis*)	Impact is estimated to be approximately 30.27 ha of habitat.	Impact is reduced to approximately 19.47 ha of habitat.	Impact is further reduced to 13.33 ha of habitat.

i Impact minimisation through outcomes-driven development controls

The planning proposal will seek to rezone land subject to future residential development to Environmental Living (C4) while remaining land on the site will be rezoned to Environmental Conservation (C2). Under the Central Coast Local Environmental Plan (LEP) 2022 (Central Coast LEP), the objectives of the Environmental Living zone are to "provide for low-impact residential development in areas with special ecological, scientific or aesthetic values".

Through proposing to rezone the land proposed for future residential development to Environmental Living, Darkinjung aim to ensure that the future land use of the subject land is low impact and is sympathetic to the surrounding retained native vegetation proposed for conservation.

Consideration for site-specific development controls would also occur as part of the mitigation strategy and includes high-level provisions to protect biodiversity at the urban-conservation interface and local values more broadly. The general development controls include:

- subdivision design that enables contiguous retention / planting of vegetation to enhance habitat and ecology including the specification of building envelopes within the individual allotments
- lot layout design to minimise ecological impacts within the development area through applying a minimum and average lot size approach.
- landscaping to prioritise repair, restoration and regeneration for ecological systems and green infrastructure corridors including restrictions on the use of exotic landscape species, and active controls to require the management of noxious weeds.
- vegetation management requirements including:
    - appropriate location of ancillary subdivision works to be located outside of environmental conservation areas, including access for works, services, bushfire asset protection, stormwater quality control structures and drainage

- preparation and implementation of a Vegetation Management Plan (VMP) for the purpose of managing construction and edge impacts
- retention of native trees and other vegetation through subdivision design
- minimal use of overhead lighting in or within proximity to the development edges.
- water quantity and quality management requirements to minimise changes to current flow patterns including measures to retain water in the landscape, retain natural topography and surface water flow paths. These include solutions such as wetlands, detention, bioretention and water-sensitive urban design measures including urban swales and passive filtration.

ii Impact minimisation via detailed design and construction measures

Where appropriate, these development controls will also be implemented under Section 88B and 88E Instruments under the *NSW Conveyancing Act 1919*, with the specific aim to:

- define the maximum permissible building envelope, proposed to encompass approximately 1,500 m^2 per envelope, which is to include ancillary development such as house gardens, outbuildings, water management including on-site waste disposal and stormwater management and dwelling access
- protect the Coastal Upland Swamp mapped within the areas proposed to be rezoned for future development, including the provision of buffers surrounding mapped extents of the Coastal Upland Swamp
- implement controls on domestic pet species and species of garden plantings to limit disturbance to areas of Coastal Upland Swamp, areas proposed to be rezoned to Environmental Conservation (C2) and additional surrounding native species and habitats
- locate the APZ, fire trail, managed green spaces and wetlands associated with stormwater detention basins within the subject land rather than adjacent retained biodiversity corridors
- implement controls on the placement of wastewater treatment facilities and to manage the quantity of surface water flows and water quality.

Darkinjung will seek the support of Central Coast Council to include the development controls in a site-specific development control plan (DCP) to be incorporated into the Gosford Development Control Plan 2013 under the Central Coast Council LEP. Darkinjung also propose to implement a Community Title or Leasehold title framework for the subject land to allow for an additional layer of control over permissible activities within the subject land. Measures will also be implemented for the shared management of the proposed fire trail, most probably through an 88B instrument supported by this additional control layer.

iii Minimisation through design location

The placement of the subject land adjacent to Reeves Street reduces biodiversity impacts by incorporating already disturbed areas into the subject land, reducing edge effects, and maintaining maximum connectivity in remaining vegetation. Connectivity through the subject land would be enhanced through the adoption of the building envelope model to create a permeable development area.

The placement of the subject land also considered the impacts to regional biodiversity corridors as identified in the Central Coast Regional Plan 2041 (DPE 2022e). The current subject land ensures that the width of a corridor between Ourimbah State Forest and Jilliby State Conservation Area in the north, and Brisbane Water National Park in the south, is largely unaffected. The subject land leaves a corridor of intact vegetation between the two areas proposed for future development, which will help to maintain connectivity between areas to the north and south of the subject land (Figure 6.1), in line with the strategies in the regional plan (DPE 2022e).

6.2 Mitigation measures

Darkinjung has committed to the design and implementation of a strategy to further mitigate the unavoidable impacts of the future development of the proposed rezoning (Umwelt 2020). The following control measures will be included:

- demarcation of approved clearance boundaries
- weed management, including removal of pine wildings during construction
- fencing and access control
- bushfire management
- pre-clearance and tree felling procedures
- measures to improve wastewater quality including minimum specifications on on-site waste disposal facilities to minimise impacts from nutrients
- water saving measures to minimise wastewater generation
- placement of wastewater treatment systems at least 40m from areas of Coastal Upland Swamp EEC and within the defined building envelopes

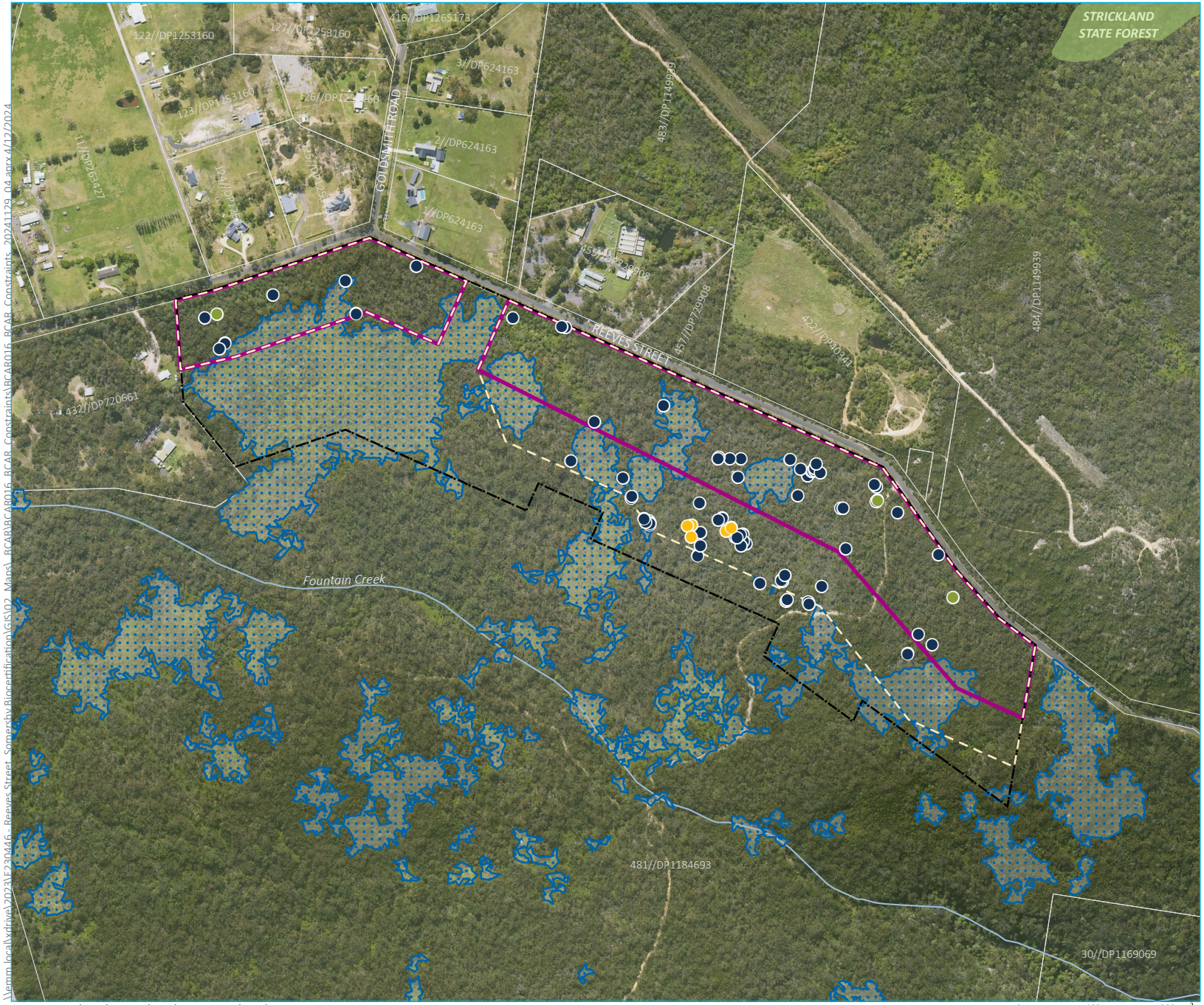
Table 6.3 summarises the proposed avoidance and minimisation measures.

Table 6.3 Mitigation and management measures

Impact	Measure	Outcome	Timing	Responsibility
Impact to Coastal Upland Swamp EEC				
Changes in hydrology	• An assessment of the surface and groundwater impacts associated with the future development of the proposed rezoning will be undertaken at the development application stage. • Building envelopes and wastewater management systems will be placed in areas to reduce impacts to the EEC. Wherever possible, a buffer zone around mapped areas of the EEC should be kept intact. A buffer zone will help protect the EEC from altered water flows and unnecessary direct impacts. • Stormwater management of the future individual allotments is proposed onsite in accordance with Water sensitive urban design (WSUD) principles. With an expected average lot size of greater than 0.95 ha the post-developed impervious fraction is anticipated to be less than 5%. The majority of the 5% impervious fraction introduced by any future dwelling is anticipated to be roof area. Roof water runoff is to be harvested for onsite reuse, with all opportunities for collection to be optimised. • The residual impervious fraction will be due to hardstand areas. This run-off will be controlled on the lot and be returned to sheet flow before reaching the lot boundary. These hardstand areas are expected to result in negligible increases in volumetric run-off, with a negligible increase in wetting of upland swamps anticipated. The controlled run-off via sheet flow will ensure nick points and erosion areas do not develop.	Avoid a decrease in run-off leading to drying, or concentration of run-off leading to nick points and erosion.	Project design	Darkinjung
Introduction of invasive flora species	• Weed and runoff management: – Removal of high-threat weed species in accordance with the *NSW Weed Control Handbook* (DPI 2018). – Prevent unmanaged runoff from development area into surrounding vegetation. – Ensure any material and equipment brought into the site is clean and free of seeds, and clean all equipment used before working in a different location. – Limit use of plantings within the subject land to non-invasive species • Establishment of a VMP.	Prevent invasive flora species from spreading outside of the subject land and into areas of upland swamp.	Pre-construction, construction and ongoing	Darkinjung, site manager and landowner
Changes in nutrient loads	• An assessment of the surface and groundwater impacts associated with the future development of the proposed rezoning will be undertaken at the development application stage. In particular this will include water quality requirements for on-site waste water management as well as on the use of fertilisers within domestic gardens.	Prevent sediment and excess nutrients from spreading outside of the subject land and into areas of upland swamp.	Project design	Darkinjung

Impact	Measure	Outcome	Timing	Responsibility
General mitigation measures				
General	A Site Plan will be included in a Construction Environmental Management Plan (CEMP) and will include: • the extent of approved disturbance • stockpile, material laydown areas and site compounds • any relevant sensitive areas. The Site Plan is to be placed in an accessible location to be viewed by all site personnel.	General mitigation measure for retained vegetation and habitat.	Pre-construction	Proponent
Fauna injury	For any clearing required pre-dwelling establishment, such as the fire trail (other services would be established at the time of dwelling construction): • Pre-clearance surveys. • Tree felling procedure • Clearing protocols to be established, including: – clearing works to be scheduled, where possible, outside of the breeding seasons for identified threatened species and other fauna species with the potential to be breeding in the subject land – clearing works to not be conducted if the temperature exceeds 35^{o}C – clearing to be conducted sequentially towards areas of broader vegetation for fauna refuge – hollow bearing trees that are felled are to be positioned on the ground so that hollows are facing upward. Coordination to be established with a veterinarian and/or wildlife clinic to ensure resourcing and capacity for potentially injured fauna prior to clearing.	Minimise impacts to fauna species within the subject land, including those that were recorded during surveys. Reduction of impacts to habitat outside of the subject land.	Prior to and during clearing activities	Site manager
Impact to retained vegetation	Demarcation of approved clearance boundaries: • Construction fencing or marking tape around areas not proposed or approved for clearing. Ensure materials, plant, equipment and stockpiles are not to be placed in a manner that could result in damage to surrounding vegetation located outside of the subject land.	Minimise impacts to surrounding vegetation and habitats.	Construction and ongoing	Site manager and landowner
	Fencing and access controls: • Restrict access to sensitive areas of the site through fencing or signage.	Minimise impacts to surrounding vegetation and habitats.	Construction and ongoing	Site manager and landowner

Impact	Measure	Outcome	Timing	Responsibility
Weed encroachment	• Weed and runoff management: – Removal of high-threat weed species in accordance with the *NSW Weed Control Handbook* (DPI 2018). – Prevent runoff from development area into surrounding vegetation. – Ensure any material and equipment brought into the site is clean and free of seeds, and clean all equipment used before working in a different location. – Prohibit the use of invasive species in domestic garden areas. • Establishment of a VMP.	Minimise environmental and noxious weeds in the subject land. Minimise weed spread into surrounding habitats and the locality. Maintain integrity of remnant patches of Coastal Upland Swamp EEC.	Construction and ongoing	Site manager and landowner
Increased risk of bushfire	Bushfire management: • Utilise cultural burning and associated complementary methods to manage both the conservation area and the subject land to manage bushfire risk.	Minimise impacts from bushfire events on retained vegetation.	Construction and ongoing	Site manager and landowner
Pathogen and disease introduction	Hygiene measures should be implemented as part of the CEMP to minimise the risk of pathogen and diseases spread on site (including Chytrid fungus), and should include procedures for equipment, footwear, and clothing. Ensure works vehicles are washed down prior to entering the works area.	Protection of Red-crowned Toadlet and Giant Burrowing Frog. Minimise indirect impacts on retained riparian vegetation, downstream receivers and any native amphibians occurring in these habitats.	Pre-construction Construction	Contractor



KEY

- Subject land (current biocertification boundary)
- Study area (previous biocertification boundary - EMM 2023)
- Previous biocertification boundary - Umwelt 2020
- Coastal Upland Swamps in the Sydney Basin Bioregion

Existing environment

- Named watercourse
- Cadastral boundary
- State forest

Species records

Umwelt (2020)

- *Hibbertia procumbens*

EMM

- *Hibbertia procumbens*
- *Prostanthera junonis*

Source: EMM (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m

GDA2020 MGA Zone 56

N

Biodiversity constraints and impact avoidance measures

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 6.1

EMM
creating opportunities

7 Assessment of impacts

Whilst no biodiversity impacts will occur as a result of the proposed rezoning, the rezoning of the site and the biocertification of the subject land is proposed to facilitate future residential development. The impacts outlined below assume that complete clearance within the subject land, including complete clearance of all APZs contained within the subject land, will occur in association with the future development of the subject land.

The following Section provides an assessment of the potential impacts associated with the future development of the proposed rezoning.

7.1 Impacts on native vegetation and habitat

7.1.1 Direct impacts

The direct impacts of the proposed rezoning will mainly be associated with clearing works within the proposed residential lots and the APZ. The impacts outlined below assume complete clearance within the subject land, including complete clearing of all APZs. Direct impacts are summarised in Table 7.1.

Table 7.1 Direct impacts within the subject land

Biodiversity value	Area within the subject land (ha)
Plant community types	
PCT 3586: Northern Sydney Scribbly Gum Woodland	2.36
PCT 3593: Sydney Coastal Sandstone Bloodwood Shrub Forest	8.70
PCT 3807: Northern Sydney Heath-Mallee	0.43
PCT 3924: Sydney Coastal Upland Swamp Heath	1.83
Total	**13.33**
Threatened ecological communities	
Coastal Upland Swamp in the Sydney Basin Bioregion	1.83
Species credit species habitat	
Eastern Pygmy-possum (*Cercartetus nanus*) (recorded)	13.33
Large-eared Pied Bat (*Chalinolobus dwyeri*) (recorded)	12.89
Giant Burrowing Frog (*Heleioporus australiacus*) (recorded)	13.33
Spreading Guinea Flower (*Hibbertia procumbens*) (recorded)	13.33
Hibbertia puberula (recorded)	8.70
Squirrel Glider (*Petaurus norfolcensis*) (recorded)	13.33
Red-crowned Toadlet (*Pseudophryne australis*) (recorded)	13.33

7.1.2 Indirect impacts

The proposed rezoning itself is not expected to cause any impacts. Subsequent development is not expected to cause substantial indirect impacts to the surrounding area and vegetation due to the implementation of mitigation measures outlined in Section 6.2. Due to the proposed zoning (Environmental Living (C4), the future land use of the subject land is expected to be low impact residential and therefore no substantial indirect impacts are expected to occur outside of the subject land in relation to habitat connectivity, corridors, habitat fragmentation or light encroachment.

Indirect impacts that could occur as a result of the proposed rezoning include the following:

- Noise impacts: Noise disturbance is likely to be highest during clearance and construction works and has the potential to impact native species by disturbing roosting and foraging behaviour, causing animals to abandon habitat, and reducing the suitability of areas of existing habitat. Upon completion of the works, noise disturbance is likely to be similar to that already experienced form the nearby Pacific Motorway. Noise from proposed residences is not expected to significantly impact threatened species or communities.

- Dust impacts: Dust impacts will only be a concern during ground disturbance works associated with clearing and construction and will be a minimal and temporary impact only. Potential impacts include dust covering vegetation which can impact the health of flora species, and subsequently impact fauna species. Controls on development following development approval would include measures to reduce dust impacts during construction activities.

- Weeds and pathogens: There is potential for weed species and pathogens to be inadvertently brought into the site with imported materials, equipment, or the establishment of gardens, and can result in the degradation of retained native vegetation and habitat. Mitigation measures outlined in Chapter 6 will be implemented to prevent the spread of weeds into surrounding areas. It is noted that there are some high threat weed species present in the study area and that measures should be taken to prevent these from spreading further.

- Surface and groundwater impacts: A formal assessment of the surface and groundwater impacts associated with the proposed rezoning will be undertaken at the development application stage. Runoff, scouring, erosion and sedimentation can impact retained native vegetation and watercourses. Areas of Coastal Upland Swamp EEC in and around the subject land are particularly susceptible to changes in surface and groundwater flows. The groundwater assessment will outline the avoidance measures to prevent hydrological impacts to the EEC outside of the subject land, as well as measure to reduce impacts to the EEC within the subject land. This will be specifically assessed as part of the development application stage, as acknowledged by Darkinjung.

7.2 Prescribed impacts

Prescribed impacts as laid out in Section 8.3 of the BAM (DPIE 2020a) are summarised in Table 7.2. One prescribed impact has been identified, being the potential impacts to hydrological processes.

Table 7.2 Identification of prescribed impacts

Feature	Present on site	Potential impact
Karst, caves, crevices, cliffs, rocks and other geological features of significance	Small rocky areas occur within the subject land. Note that one of the rock platforms present within the site will not be impacted by the proposed residential development and has been excluded from development plans due to the presence of Aboriginal Heritage Items.	No substantial impact expected given the limited extent of rocky habitat present.
Human-made structures	No	N/A
Non-native vegetation	No areas of non-native vegetation are present within the subject land. The section of the subject land where the canopy is dominated by Cluster Pine has been mapped as PCT 3593 in a 'Pine' condition state, as the vegetation is otherwise predominantly native. This area is habitat for Spreading Guinea Flower (*Hibbertia procumbens*) and *Hibbertia puberula*.	N/A
Habitat connectivity	The subject land sits within a corridor of native vegetation approximately 3 km wide, connecting Ourimbah State Forest and Jilliby State Conservation Area in the north to Brisbane Water National Park in the south, as identified in the Central Coast Regional Plan 2041 (DPE 2022e).	Impacts to connectivity are considered to be minor, given that the subject land is located adjacent to Reeves Street and existing cleared lots. The proposed rezoning proposes to impact a relatively small proportion of this area of native vegetation. The current footprint leaves a corridor of intact vegetation between the two proposed development areas, which will help to maintain connectivity between areas to the north and south of the footprint (Figure 6.1). Impacts to connectivity will likely only affect species that are not particularly mobile such as threatened flora species. There will be no significant loss of fauna movement habitat.
Water bodies, water quality and hydrological processes	No waterbodies or waterways exist within the subject land. Fountain Creek is mapped to the south of the subject land. Waterways within the subject land are limited to drainage lines originating at Reeves Street.	If mitigation measures mentioned in Chapter 6 are implemented, as well as any recommendations from an update to the existing surface and groundwater assessment to respond to the changed area of the subject land, no impacts on water quality or hydrological processes are expected to occur beyond the subject land. The updated surface and groundwater assessment will contain more information on whether alterations to hydrological processes will occur and future development will be designed to ensure there is no impact to downstream communities. A decrease or increase in available groundwater or surface water seepage could have negative impacts on the integrity and longevity of the Coastal Upland Swamp EEC mapped in and around the subject land.
Wind turbine development	No	N/A
Vehicle strikes	Access to the proposed future development will occur via Reeves Street. The proposed residences along Reeves Street will result in an increase in local vehicle movement. One fire trail will be constructed within the subject land, but this will be rarely used, and traffic will be negligible.	The increase in traffic along Reeves Street has the potential to increase incidence of vehicle strike, but this is expected to be minor and not substantial enough to lead to a decline in any threatened species.

7.3 Serious and Irreversible impacts

An impact is to be regarded as a serious and irreversible impact (SAII) if it is likely to contribute significantly to the risk of a threatened species (including endangered populations) or an ecological community becoming extinct based on the following four principles:

- Principle 1: The impact will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.
- Principle 2: The impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.
- Principle 3: The impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.
- Principle 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable.

Candidate SAII entities for the proposed rezoning are discussed in the following sections against the relevant principles for the listing of the SAII entity, based on information from the Threatened Biodiversity Data Collection (TBDC).

7.3.1 Threatened ecological communities

Section 9.1.1 of the BAM (DPIE 2020a) requires additional impact assessment for threatened ecological communities that are also listed as candidate entities for SAII. One TEC listed under the BC Act occurs within the subject land:

- Coastal Upland Swamp EEC.

This EEC is listed as an entity at risk of SAII and is assessed below. Measures to avoid impacts to this EEC are outlined in Section 6.1.

i Coastal Upland Swamps in the Sydney Basin Bioregion

a Current status

Table 7.3 Current status – Coastal Upland Swamps in the Sydney Basin Bioregion EEC

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of reduction in geographic distribution (Principle 1):			
Current total geographic extent (ha) of the threatened ecological community (TEC) in NSW	5,360 ha	TSSC 2012 (point 14)	Estimate is based on an amalgamation of the best available regional vegetation mapping throughout the range of the community (NPWS 2000a, DECCW 2009, Tozer et al. 2010).

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Estimated reduction in geographic extent of the TEC since 1970	An estimated 10% of the historical distribution is likely to have been destroyed by clearing, and most clearing occurred after 1970. Based on the current extent of 5,360 ha, an estimated 596 ha has been lost since 1970.	TSSC 2012	Precise estimates of the reduction in extent are not available as there is no estimate of the extent in 1970. Clearing has occurred due to the construction of roads, railways, quarries, mining infrastructure, golf courses, and agriculture.
Extent of reduction in ecological function, describing the degree of environmental degradation or disruption to biotic processes (Principle 2)	The Threatened Biodiversity Profile description lists the following threats affecting the ecological function of the TEC: • alteration of habitat including hydrology following subsidence due to long wall mining • changes in climatic moisture associated with climate change • alteration of fire regimes • clearing, disturbance, runoff and sedimentation associated with infrastructure, quarries, surface facilities and recreational facilities • localised disturbance associated with unauthorised recreational activities including access by vehicles, trailbikes and horses • browsing and soil disturbance by deer and pigs • loss of diversity from an over-abundance of large shrubs • infection of native plants by *Phytophthora cinnamomi*. These threats affect the ecological function of the TEC at varying levels and lead to different states of the TEC. The extent to which this reflects a permanent or temporary loss depends on the mechanism and severity of disturbance as well as any measures that are undertaken to reverse decline. As such, the extent of reduction in ecological function is unknown. Although there is no systematic regional analysis of the impacts of mine subsidence on upland swamps, impacts have been documented in multiple swamps in the Avon, Cordeaux and Woronora catchment areas. Ground subsidence and warping from underground mining may occur up to 3 km outside the mining footprint and continue several years after extraction. The impacts on upland swamps are difficult to detect partially due to time lags in hydrological and ecological processes, and interaction with climatic conditions and fire. Changes in community species composition may not be evident until multiple fire cycles after mining is completed. Thus, the extent of the impacts from current mining practices is likely to increase into the future. Almost all Coastal Upland Swamps on the Woronora Plateau are subject to existing underground mining leases.	DPIE 2020b TSSC 2012 (point 17 climate, 18 mining)	Most of the available information is qualitative only, and data on the actual extent of reduction is not available. In the case of mining subsidence, the reduction in ecological function is difficult to quantify, because impacts from current mining operations may increase in the future. There are specific examples of impacts to the ecological function of the TEC, but no regional level study or quantification.

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
	Impacts on upland swamps from altered fire regimes include increased erosion following substrate fires and heavy rainfall, a decline in plant species that seed after fire due to decreased fire intervals (serotinous obligate seeders), and increased shrub density and decreased understorey plants due to increased fire intervals. Examples of these impacts have been documented in the Woronora Plateau and in O'Hare's Creek catchment. Future habit loss through clearing is limited as much of the remaining distribution of the TEC is within public land managed by the Sydney Catchment Authority and NPWS. Areas of the TEC on private land remain at risk of clearing through development. Climate modelling indicates that the climate within the TEC distribution will become warmer and drier, with more frequent and intense fires. The distribution of suitable habitat for Coastal Upland Swamps is projected to contract, along with a decline in ecological and hydrological functions. A decline in distribution of around 70% is likely in the next 50 years (TSSC 2012 , Keith et al 2010).		
Evidence of restricted geographic distribution (Principle 3) based on the TEC's geographic range in NSW:			
Extent of occurrence (ha)	4,960 [4,730-5,200] km^2	TSSC 2012	Based on a two x 2 km grid (the spatial scale recommended by IUCN for assessing species area of occupancy).
Area of occupancy (ha)	1,140 [1,100-1,200] km^2	TSSC 2012	Based on a two x 2 km grid (the spatial scale recommended by IUCN for assessing species area of occupancy).

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of threat-defined locations	The BAM (DPIE 2020a) defines threat-defined locations in terms of threatened species but does not mention TECs. According to the Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria (Bland et al. 2017), a threat-defined location is: • a geographically or ecologically distinct area in which a single threatening event can rapidly affect all occurrences of an ecosystem type. The IUCN definition is similar to that included in the BAM and is considered to encompass the intent of the requirements of the BAM for TECs. The most serious plausible threats to the TEC are mining subsidence and alteration to fire regimes. Almost all upland swamps in the Woronora Plateau (where most of the TEC occurs) are subject to underground mining leases, and therefore vulnerable to subsidence impacts. All occurrences could be impacted by one severe fire season like that seen in 2019-2020. One interpretation of threat-defined locations is based on biogeographical regions (bioregions). This would produce an estimate of one threat-defined location, given that the TEC only occurs in the Sydney Basin Bioregion.	TSSC 2012 Bland et al. 2017	Data is not strictly defined by the BAM. Assumptions have been made from additional data sources.

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence that the TEC is unlikely to respond to management (Principle 4)			
Evidence that the TEC is unlikely to respond to management	There is no data to suggest that the TEC is unlikely to respond to management. The Threatened Biodiversity Profile description lists the following activities to assist the TEC: • assess, avoid and mitigate impacts arising from proposed developments, in particular longwall coal mining on the Woronora Plateau • carry out an Audit of all swamps and their impacts to prioritise for protection or restoration • manage fire regimes to reduce fire frequency, avoid subsurface fires (in peat soils), predicted changes in fire frequency and intensity associated with climate change • monitor the predicted changes in climatic moisture and fire regimes associated with climate change • manage unauthorised access. Additionally, Saving our Species have prepared a strategy for the TEC which identifies "the priority management areas and conservation actions required to manage critical threats to conserve the ecological community" and "aims to secure the ecological community in the long term". From the recommended management actions, it is evident that there is a focus on managing the hydrological regime associated with the TEC (particularly in relation to mine subsidence and climate change), managing the fire regime in areas of the TEC, and managing access to areas of the TEC. Much of the remaining distribution of the TEC is within public land managed by the Sydney Catchment Authority and NPWS and there is no data to suggest that adequate application of the recommended management actions would be unsuccessful for the TEC.	DPIE 2020b TSSC 2012 DPHI n.d.a	Available information is in relation to recommended actions to manage the TEC ,with no data relating to the outcomes of the application of these actions.

b Impact assessment

Table 7.4 Impact assessment - Coastal Upland Swamps in the Sydney Basin Bioregion EEC

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Impact on the geographic extent of the TEC (Principles 1 and 3)			
Area of TEC to be impacted by the proposal (ha)	The proposed rezoning would impact on: • 1.83 ha of Coastal Upland Swamp TEC.	-	-
Area of TEC to be impacted by the proposal as a % of the current geographic extent in NSW (%)	The best estimate of the extent of occurrence (EOO) is 4,960 km^2. 1.83 ha of impact indicates that the proposed rezoning would impact on 0.00037% of its current extent.	TSSC 2012	EOO is based on a two x 2 km grid (the spatial scale recommended by IUCN for assessing species area of occupancy).
Direct/indirect impacts likely as a result of the proposal to contribute to loss of flora/fauna species characteristic of the TEC	The proposed rezoning would result in the direct removal of 1.83 ha of the TEC, which is 0.00037% of its current extent. Indirect impacts to the TEC may include weed introduction and spread, and surface and groundwater impacts. Retained areas of the TEC outside the subject land will be avoided. Weed management and erosion mitigation measures in accordance with Table 6.3 will also be developed and implemented in retained areas of the community.	-	-
Impacts likely to contribute to further environmental degradation or disruption of biotic processes (Principle 2)			
Remaining extent of isolated areas of TEC (ha)	Within the extent of the lot boundary, an estimated 22.78 ha of the TEC remains outside of the subject land. Within the 1,500m buffer area, there is an additional 35.15 ha.	This calculation is based on a composite of EMM's PCT mapping (applied within the study area, see Figure 4.1), and EMM's modelling of potential upland swamp extent (applied outside the study area, see section 4.2.2ii and Figure 6.1).	The modelling outside of the study area has not been ground-truthed by EMM and is based off a canopy height model only.
Average distance between remaining remnants – remnant is retained (m)	The average distance between areas of the TEC, without the impacts of the proposed rezoning, is 24.26 m.	As above.	As above.

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Average distance between remaining remnants – remnant is removed (m)	The average distance between areas of the TEC, after the proposed clearing goes ahead, would be 24.37 m. This slight change in distance indicates very little change to connectivity and fragmentation in the 1,500 m buffer area based on this metric.	As above.	As above.
Estimated maximum dispersal distance of species associated with the TEC (km)	According to Corlett (2009), typical maximum dispersal distances for different dispersal mechanisms are as follows: • no specialised mechanism 0–10 m • Ant dispersal 0–10 m • wind (large-winged fruits) 10–100 m • rodents 10–100 m • small to medium-sized forest birds and arboreal mammals 100 m–1 km • Flying-foxes (large seeds) 100 m–1 km • large and open-country birds 1–10 km • wind (small plumed seeds) 1–10 km • terrestrial mammals 1–10 km • wind (tiny seeds/spores, and very small plumed seeds) >10 km • Flying-foxes (small seeds) >10 km. Many of the species recorded within the TEC do not have a specific seed dispersal mechanism and likely drop their seeds over only a short dispersal distance, which may then be carried further by wind or water. The seeds of some species recorded are dispersed by wind and may travel up to 10km. This includes *Gleichenia dicarpa* (spores), Hakea sp. and Banksia sp. (winged seeds), *Isopogon anemonifolius*, *Xanthorrhoea resinosa*, *Leptospermum polygalifolium* (very small and light seeds), and *Parsonsia straminea* (seeds have long hairs to aid wind dispersal). Animals such as birds are known to assist the dispersal of *Gahnia clarkei* seeds, which may carry the seeds up to 1 km.	Corlett 2009	-
Area to perimeter ratio of remaining remnants (ratio)	The current area to perimeter ratio of remaining remnant of the TEC in the buffer area is 0.00116. Taking into account the potential clearing within the subject land, the ratio would become 0.00115. This slight change in ratio indicates very little change to connectivity and fragmentation in the 1,500 m buffer area based on this metric. The potential clearing within the subject land will not cause further fragmentation of remnant patches. Where areas of swamp may be affected, it is on the edge of mapped areas rather than fragmenting. It is noted that the ratios calculated are small, likely due to the fragmented nature of the TEC mapping in the remainder of the lot boundary (see Figure 6.1).	This calculation is based on a composite of EMM's PCT mapping (applied within the study area, see Figure 4.1), and EMM's modelling of potential upland swamp extent (applied outside the study area, see section 4.2.2ii and Figure 6.1).	The modelling outside of the study area has not been ground-truthed by EMM and is based off a canopy height model only.

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Vegetation integrity analysis			
Vegetation zone 1: 3924_High (Composition score)	36.1	-	-
Vegetation zone 1: 3924_High (Structure score)	4.2	-	-
Vegetation zone 1: 3924_High (Function score)	-	-	-

7.3.2 Threatened species

Section 9.1.2 of BAM (DPIE 2020a) requires additional impact assessment for threatened species that are also listed as candidate entities for SAII.

Based on assessment of habitat suitability and targeted surveys, there is one candidate entity for SAII relevant to this assessment; Large-eared Pied Bat (*Chalinolobus dwyeri*) (recorded in the subject land).

Additionally, CPHR has requested that impacts to the Somersby Mintbush (*Prostanthera junonis*) be assessed as a potential SAII entity, despite not being listed as such in the TBDC. There will be no impacts to Somersby Mintbush as the species was not recorded within the subject land. An SAII assessment is included below regardless.

Details of these two species are included in the following sections.

i Large-eared Pied Bat

The breeding habitat of this species is listed as a potential SAII. For breeding habitat to be considered present in the subject land, there must be potential breeding habitat and breeding individuals present.

The potential breeding habitat for this species includes (DPIE 2021):

> The PCTs associated with the species (as per the TBDC) within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Traps should be set in woodlands, valley floors, riparian areas and relatively fertile parts of the subject land where possible.

EMM surveyed for potential breeding habitat both within the study area and within a buffer of 100 m, searching for potential breeding and roosting habitat in the steepest areas where there was the highest potential for habitat to occur. Even in the steepest areas, there is very minimal rocky habitat within this area, with no suitable caves, overhangs or crevices, and no potential breeding habitat was identified (see Figure 5.2).

Large-eared Pied Bat was recorded during acoustic surveys for microbats in November 2023. It was not detected during subsequent harp trapping surveys in January 2024. Hence no breeding individuals were detected.

The combination of no potential breeding habitat within the subject land or within 100 m, and no breeding individuals, means that SAII is not triggered and standard species credits will be generated for this species (see Section 5.4.5 and Section 7.4).

ii Somersby Mintbush

Somersby Mintbush will be assessed as an SAII entity, on request from CPHR (previously the Biodiversity and Conservation Division (BCD):

> BCD considers any impacts on the Somersby Mintbush (*Prostanthera junonis*) or its habitat to be a potential Serious and Irreversible Impact (SAII), as this species meets three of the SAII principles outlined in Section 6.7 of the Biodiversity Conservation Regulation 2017 as the species is:
>
> - observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline
>
> - observed, estimated, inferred or reasonably suspected to have a very small population size
>
> - observed, inferred or estimated to have very limited geographic distribution.

As Somersby Mintbush is not listed as a potential SAII species in the TBDC, there is no available data in the TBDC with reference to each of the SAII principles. As mentioned above, there are no records of Somersby Mintbush within the subject land, and the species will not generate species credits. Despite this, an SAII assessment has been completed for the Somersby Mintbush as a conservative measure. The assessment for this species is provided in Table 7.5 and Table 7.6.

a Current status

Table 7.5 Current status – Somersby Mintbush

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or three generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Longevity of the species is unknown, some evidence that the species has a longevity of more than 20 years. In that case, three generations would be approximately 60 years. It is assumed that Somersby Mintbush was once more widespread on the Somersby Plateau, however there is no direct evidence.	TSSC 2016 NPWS 2000b	The longevity of the species is not confirmed, and there is no data on its historical distribution.
Evidence of small population size (Principle 2)			
Current population size in NSW	More than 3,200 plants in 2000.	TSSC 2016	There is limited available data on the full extent of the population. The most recent estimate cited is from 2000.
Decline in species' population size in 3 years or one generation	One generation is estimated to be more than 20 years, although this is not confirmed. The most recent estimate of population size was carried out in 2000 (approximately 20 years ago) and there is no updated data available.	TSSC 2016	There is limited available data on the current full extent of the population. The most recent estimate cited is from 2000.

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	A range of plant sizes are found in each population. It is difficult to determine the age structure of the population as the width of the stem does not increase with age, and plants can reproduce vegetatively via stolons. Adult plants are likely to be killed by fire, suggesting that populations could undergo extreme fluctuations, however there is also evidence of post-fire recruitment of the species. It appears that recruitment also occurs in the absence of fire, given the range of plant sizes in each population. The species may undergo fluctuations based on site conditions and fire regime, however given its mixed reproduction mechanisms (vegetative from adults and seed recruitment), the demographics within each population are difficult to determine.	TSSC 2016 NPWS 2000b	There is limited information available. The demographics are difficult to determine, as the size of plants may be more related to site conditions than age.
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	47 km^2	TSSC 2016	While individual populations at four priority management sites are being monitored through the Saving our Species strategy (DPHI n.d.b), there is no more recent estimate of the extent of occurrence or area of occupancy for the whole species since the conservation advice was published in 2016 (TSSC).
Area of occupancy (ha)	36 km^2	TSSC 2016	While individual populations at four priority management sites are being monitored through the Saving our Species strategy (DPHI n.d.b), there is no more recent estimate of the extent of occurrence or area of occupancy for the whole species since the conservation advice was published in 2016 (TSSC).
Number of threat-defined locations	Somersby Mintbush is known from nine populations on the Somersby Plateau. These locations are all within a geographic area of 19 km (north-south) by 7 km (east-west). It is feasible that a single threatening event could impact on all occurrences of the species in this area, making them one threat-defined location.	TSSC 2016	-

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Whether the species' population is likely to undergo extreme fluctuations	Adult plants are likely to be killed by fire, suggesting that populations could undergo extreme fluctuations, however there is also evidence that fire triggers seedling recruitment. It appears that recruitment also occurs in the absence of fire, given the range of plant sizes in each population. The species may undergo fluctuations based on site conditions and fire regime, however given its mixed reproduction mechanisms (vegetative from adults and seed recruitment), the demographics within each population are difficult to determine.	TSSC 2016 NPWS 2000b	There is limited information available. The demographics are difficult to determine, as the size of plants may be more related to site conditions than age.

b Impact assessment

Table 7.6 Impact assessment – Somersby Mintbush

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	None recorded within the subject land.	-	-
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	Nil.	-	-
Number of individuals (mature and immature) to be impacted by the proposal	Nil.	-	-
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	Nil.	-	-
Area of habitat to be impacted (ha) (for species measured by area only)	No species polygon has been generated for this species as there are no records within the subject land.	-	-
Area of the species' geographic range to be impacted by the proposal (ha)	13.4 ha Whilst the species has not been recorded within the subject land, 13.4 ha is the total area of the subject land that lies within the geographic range of the species.	-	-
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	13.4 ha / 4,700 ha (EOO) = 0.29%	-	-

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Individuals impacted	Nil.	-	-
Viability of a fragmented population	No population will be fragmented by the proposed rezoning.	-	-

7.4 Biodiversity credit report

7.4.1 Impacts to native vegetation

A summary of ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, is provided in Table 7.7. A total of 309 ecosystem credits are required to offset the residual impact of the proposed rezoning. Credit reports are provided in Appendix C.

Table 7.7 Summary of impacts requiring ecosystem credits

Vegetation zone ID	PCT ID	Condition	Area (ha)	Future vegetation integrity score	Change in vegetation integrity score	Potential SAII	Credits required
3586_High	3586	High	2.09	0	63.9	False	50
3586_Open	3586	Open	0.27	0	65.6	False	7
3593_High	3593	High	7.68	0	75.9	False	219
3593_Disturbed	3593	Disturbed	0.24	0	40.8	False	4
3593_Pines	3593	Pines	0.77	0	48.8	False	14
3807_High	3807	High	0.43	0	95.9	False	15
3924_High	3924	High	1.83	0	12.4	True	0

It is acknowledged that the vegetation integrity score for PCT 3924 is lower than expected and has resulted in the vegetation zone not generating a credit requirement. This may be an issue with the benchmark data used in the BAM-C. For this vegetation zone, collection of local benchmark data may be a more appropriate approach, which may lead to the vegetation zone generating a credit requirement. Considering that this vegetation zone comprises a TEC and is an SAII entity, this issue will be further discussed during consultation.

7.4.2 Impacts to threatened species

A summary of the species credits required for all vegetation zones occupied by the threatened species, including changes in vegetation integrity score, are provided in Table 7.8. A total of 2820 species credits are required to offset the residual impacts of the proposed rezoning. Credit reports are provided in Appendix C.

Table 7.8 Summary of impacts requiring species credits

Vegetation zone name	Habitat condition (VI) loss	Area (ha)	Potential SAII	Biodiversity Risk Weighting	Species credits
Eastern Pygmy-possum			**False**	**2**	**423**
PCT 3586 – High	-63.9	2.09	-	-	
PCT 3586 – Open	-65.6	0.27	-	-	
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	

Vegetation zone name	Habitat condition (VI) loss	Area (ha)	Potential SAII	Biodiversity Risk Weighting	Species credits
PCT 3593 – Pines	-48.8	0.77	-	-	
PCT 3807 – High	-95.9	0.43	-	-	
PCT 3924 - High	-12.4	1.83	-	-	
Large-eared Pied Bat			**True (breeding only)**	**3**	**602**
PCT 3586 – High	-63.9	2.09	-	-	
PCT 3586 – Open	-65.6	0.27	-	-	
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	
PCT 3593 – Pines	-48.8	0.77	-	-	
PCT 3924 - High	-12.4	1.83	-	-	
Giant Burrowing Frog			**False**	**1.5**	**317**
PCT 3586 – High	-63.9	2.09	-	-	
PCT 3586 – Open	-65.6	0.27	-	-	
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	
PCT 3593 – Pines	-48.8	0.77	-	-	
PCT 3807 – High	-95.9	0.43	-	-	
PCT 3924 - High	-12.4	1.83	-	-	
Spreading Guinea Flower			**False**	**2**	**423**
PCT 3586 – High	-63.9	2.09	-	-	
PCT 3586 – Open	-65.6	0.27	-	-	
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	
PCT 3593 – Pines	-48.8	0.77	-	-	
PCT 3807 – High	-95.9	0.43	-	-	
PCT 3924 - High	-12.4	1.83	-	-	
Hibbertia puberula			**False**	**2**	**315**
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	

Vegetation zone name	Habitat condition (VI) loss	Area (ha)	Potential SAII	Biodiversity Risk Weighting	Species credits
PCT 3593 – Pines	-48.8	0.77	-	-	
Squirrel Glider			**False**	**2**	**423**
PCT 3586 – High	-63.9	2.09	-	-	
PCT 3586 – Open	-65.6	0.27	-	-	
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	
PCT 3593 – Pines	-48.8	0.77	-	-	
PCT 3807 – High	-95.9	0.43	-	-	
PCT 3924 - High	-12.4	1.83	-	-	
Red-crowned Toadlet			**False**	**1.5**	**317**
PCT 3586 – High	-63.9	2.09	-	-	
PCT 3586 – Open	-65.6	0.27	-	-	
PCT 3593 – High	-75.9	7.68	-	-	
PCT 3593 – Disturbed	-40.8	0.24	-	-	
PCT 3593 – Pines	-48.8	0.77	-	-	
PCT 3807 – High	-95.9	0.43	-	-	
PCT 3924 - High	-12.4	1.83	-	-	

8 Biodiversity certification offsets and strategy

The future development of the proposed rezoning will offset the residual impacts on biodiversity via conservation mechanisms established under the NSW Biodiversity Offset Scheme (BOS). The BOS offset rules are established by the Biodiversity Conservation Regulation 2017 and the mechanisms available to meet offset obligations include:

- retiring like-for-like credits
- payment into the Biodiversity Conservation Fund (BCF).

The certification of the subject land will require the retirement of 309 ecosystem credits and 2,820 species credits.

The majority of the site will be rezoned to C2, and is intended to be used for offsets. As much as possible Darkinjung will be offsetting within the site by entering into a Biodiversity Stewardship Agreement (BSA).

8.1 Proposed offset strategy

Darkinjung is one of the largest landholders on the Central Coast of NSW currently owning approximately 3,700 ha of land across the Central Coast LGA. Darkinjung has developed a draft Conservation Estate Strategy (EMM 2023b) outlining opportunities for the LALC to generate a supply of biodiversity credits through the development of BSAs on LALC-owned land. This credit supply can be used to offset development of sites identified in the DDP, as well as supply to the broader market. In turn, this can help Darkinjung to achieve social, economic and environmental outcomes for the Darkinjung community, including reinvestment in a revolving fund to progress additional BSAs.

The draft Conservation Estate Strategy (EMM 2023b) identifies an opportunity for Darkinjung to utilise the residual of Lot 481 DP 1184693 (the site) that is not proposed for biocertification to address credit obligations for certification. As the area of the site proposed to be rezoned to Environmental Conservation (herein referred to as the 'proposed conservation land'; refer to Figure 8.1) supports contiguous vegetation, it is predicted to be capable of supplying matching credits for the subject land. The offsets would be delivered by securing this land under a BSA to be established under Part 5 Division 2 of the BC Act.

8.1.1 Ecosystem credit potential of the proposed conservation land

i Method

An estimate of the ecosystem credit generation of the proposed conservation land was calculated by undertaking the following steps:

- Assess type and extent of PCTs by performing a geometric union between the NSW State Vegetation Type Map (SVTM) C2.0.M2.1 (November2024) release (NSW DCCEEW 2024) and the proposed conservation area in ArcMap (version 10.8.2).
- Assign Offset Trading Group (OTG) to each PCT, using vegetation class for non-TEC PCTs and TECs for relevant PCTs. TEC trading groups were based on PCTs to TEC associations derived from the BioNet Vegetation Classification and using the judgement of the author.
- Estimate credit generation by using existing plot data collected from the study area to calculate vegetation integrity scores for each PCT in the BAM calculator.
- Where plot data does not exist for a specific PCT, estimate credit generation by multiplying the extent of the relevant PCT (in hectares) by values between 4.7 and 6.1 credits per hectare. These values are based on summarised data released by the Biodiversity Conservation Trust (BCT) in February 2024 derived from other Biodiversity Steward Sites across NSW.

ii Limitations

- PCT mapping is based on statewide vegetation mapping. Whilst providing a reasonable estimate of potential credit generation, PCTs will need to be verified in the field as part of feasibility and subsequent detailed assessment phases of a BSA project.

- TEC trading groups should be treated with a degree of caution until feasibility assessments are undertaken. The feasibility assessment will need to determine whether PCTs observed on a site are aligned with TECs.

iii Key findings

Based on the above high-level assessment, the potential conservation land is predicted to be capable of generating 842 ecosystem credits across four offset trading groups. It is estimated that of these credits approximately 793 credits can be generated that will fully address the credit requirement for credit types within the *Sydney Coastal Dry Sclerophyll Forests; <50%* offset trading group (Table 8.1).

The SVTM dataset does not identify credit types belonging to the *Sydney Coastal Heaths; <50%* offset trading group but there is a 15-credit offset requirement for certification of the subject land. The vegetation mapping of the study area derived from field survey identifies PCT 3807 and indicates that the distribution of this PCT extends into the proposed conservation land. The presence and extent of PCT 3807 would be determined via future ground-truthing surveys of the proposed conservation land in line with the BAM (DPIE 2020a) for a future stewardship site assessment.

Although Coastal Upland Swamp TEC does not generate a credit requirement within the subject land, it is estimated based on the SVTM that the proposed conservation land will conserve an estimated 13 ha of the TEC and generate at least 10 credits. Modelled Coastal Upland Swamp mapping indicates that the extent of the TEC may be larger than this (see Figure 6.1, and Section 4.2.2ii for modelling methods).

Table 8.1 Potential ecosystem credit generation from proposed conservation lands at the proposed conservation land (indicative)

Offset trading group	Credit types	Estimated credit generation in proposed conservation land	Credits required for biodiversity certification	Residual credits required
Coastal Upland Swamp in the Sydney Basin Bioregion	3924 - Sydney Coastal Upland Swamp Heath	20	0	0
Northern Warm Temperate Rainforests; <50%	3041 - Sydney Sandstone Coachwood-Grey Myrtle Rainforest	2	0	0
Sydney Coastal Dry Sclerophyll Forests; <50%	3586 - Northern Sydney Scribbly Gum Woodland 3593 - Sydney Coastal Sandstone Bloodwood Shrub Forest 3595 - Sydney Coastal Sandstone Gully Forest 3596 - Sydney Coastal Sandstone Riparian Forest	793	294	0
Sydney Coastal Heaths; <50%	3807 - Northern Sydney Heath-Mallee	5	15	15

Offset trading group	Credit types	Estimated credit generation in proposed conservation land	Credits required for biodiversity certification	Residual credits required
Sydney Hinterland Dry Sclerophyll Forests; <50%	3621 - Sydney Hinterland Turpentine-Apple Gully Forest	22	0	0
Grand Total		**842**	**309**	**15**

8.1.2 Potential for species credit generation on the proposed conservation land

The proposed conservation land is predicted to be capable of addressing offset requirements for species credits for the subject land. This includes species credits for:

- Eastern Pygmy-possum (*Cercartetus nanus*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Giant Burrowing Frog (*Heleioporus australiacus*)
- Spreading Guinea Flower (*Hibbertia procumbens*)
- *Hibbertia puberula*
- Squirrel Glider (*Petaurus norfolcensis*)
- Red-Crowned Toadlet (*Pseudophryne australis*).

However, the quantum of credits that can be generated will need to be determined through targeted survey as part of a future stewardship site assessment.

Although not required to be offset, the proposed conservation land is also known to support a population of Somersby Mintbush (*Prostanthera junonis*; refer to Figure 6.1), which has been assessed as a candidate for SAII in Section 7.3.2ii.

8.2 Approach to addressing residual credit requirements not met by the proposed conservation land

Detailed assessment to address the requirements for a Biodiversity Stewardship Site Assessment Report (BSSAR) would need to be undertaken to formally assess the credit-generation potential of the proposed conservation land and to progress to a BSA.

Where the credit generation cannot be fully met onsite, measures to address the balance will include:

- sourcing additional conservation opportunities within Darkinjung's larger conservation estate
- seeking like-for-like credits on the credit market
- if required, seeking approval to offset under the variation offset rules
- if required, payment into the BCF.

Source: EMM (2024); DCSSS (2023); DCCEEW (2024); OEH (2017); Esri (2024)

\\emm.local\xdrive\2023\E230446 - Reeves Street, Somersby Biocertification\GIS\02_Maps_BCAR\BCAR018_ProposedConservationLand\BCAR018_ProposedConservationLand_20250519_02.aprx 19/05/2025

Proposed conservation land

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Biodiversity Certification Assessment Report
Figure 8.1

EMM
creating opportunities

9 Assessment of the project against the *Environment Protection and Biodiversity Conservation Act 1999*

This chapter provides an assessment of the impacts of the future development of the proposed rezoning to species and communities listed under the EPBC Act, known as Matters of National Environmental Significance (MNES). The MNES with potential to be impacted by the proposed rezoning include one threatened ecological community, three threatened flora species, and ten threatened fauna species.

9.1 Likelihood of occurrence assessment

A desktop assessment was completed to develop a list of MNES with potential to occur in the study area, as outlined in Step 1 of Section 5.1. As well as species and communities generated by the PMST, EPBC listed entities have been added based on existing species records from the region, and associations with the PCTs recorded within the study area.

A likelihood of occurrence assessment was conducted for all MNES with some potential to occur in the subject land. All MNES entities were assessed against the criteria shown in Table 9.1, using desktop information in combination with the field surveys completed. The full assessment is provided in Appendix E, including justifications as to whether or not species or communities are considered to have potential of occurring in the study area. The outcomes of the assessment are summarised in the sections below and species and communities deemed likely to be impacted are assessed further in Section 9.2.

Table 9.1 Likelihood of occurrence criteria

Likelihood	Description	Further assessment conducted?
Negligible	• There is no potential for the species to occur in the subject land. • The species was not recorded during targeted surveys in the subject land.	No
Low	• Based on data collected during field investigations it was considered that the species was unlikely to occur in the subject land or use habitats in the subject land. A species may utilise the subject land on rare occasions. • The species is considered vagrant in the bioregion and is thus considered unlikely to occur in the locality.	No
Moderate	• The species is known to occur in the bioregion and the subject land provides some habitat value for the species. Habitat values are somewhat degraded and considered suboptimal.	Yes
High	• The species is known to occur in the bioregion and the subject land supports optimal habitat features for the species.	Yes
Known	• The species was recorded in the subject land during the current surveys. • The species has been recorded in the subject land previously and there has not been any change in habitat values since this time.	Yes

9.2 Significant impact assessments

Following the likelihood of occurrence assessment, thirteen species and one TEC listed under the EPBC Act were considered to have a moderate or higher likelihood of occurrence within the study area.

For the identified MNES, the impacts of the proposed rezoning has been assessed according to the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DEWHA 2013). The significant impact assessments are provided in Appendix E with a summary of the results provided in Table 9.2.

Table 9.2 Summary of the species considered likely to occur within the subject land and outcomes of significant impact assessments

Scientific name	Common name	EPBC Act status[1]	Likelihood of occurrence	Significant impact assessment outcome
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	Known	Unlikely
Chalinolobus dwyeri	Large-eared Pied Bat	E	Known	Likely
Coastal Upland Swamps in the Sydney Basin Bioregion		E	Known	Unlikely
Dasyurus maculatus maculatus (SE mainland population)	Spotted-tail Quoll (southeastern mainland population)	E	High	Unlikely
Heleioporus australiacus	Giant Burrowing Frog	V	Known	Likely
Hirundapus caudacutus	White-throated Needletail	V	High	Unlikely
Lathamus discolor	Swift Parrot	CE	Moderate	Unlikely
Litoria littlejohni	Littlejohn's Tree Frog	E	Moderate	Unlikely
Melaleuca biconvexa	Biconvex Paperbark	V	Moderate	Unlikely
Petaurus australis australis	Yellow-bellied Glider (south-eastern)	V	High	Unlikely
Prostanthera junonis	Somersby Mintbush	E	High	Unlikely
Pseudomys novaehollandiae	New Holland Mouse, Pookila	V	Moderate	Unlikely
Pteropus poliocephalus	Grey-headed Flying-fox	V	High	Unlikely
Rutidosis heterogama	Heath Wrinklewort	V	Moderate	Unlikely

Note

1. V = Vulnerable, E = Endangered, CE = Critically Endangered

The assessments concluded that that significant impacts to MNES are likely for two threatened species:

- Large-eared Pied Bat
- Giant Burrowing Frog

Any future development application would require referral to the Commonwealth DCCEEW for determination.

10 Conclusions

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM (DPIE 2020a) with impacts assessed under the BC Act and the EPBC Act.

Field surveys within the study area have been carried out by Umwelt and EMM between 2018 and 2024, comprising vegetation surveys, threatened flora surveys and threatened fauna surveys. These surveys have led to a good understanding of the key biodiversity values present within the study area and broader site and have been carried out in parallel with, and informed the evolution of, the design of the planning proposal and area proposed for biocertification (subject land). This process has ensured the avoidance and minimisation of biodiversity constraints as far as practicable.

Residual impacts comprise the clearing of 13.32 ha of native vegetation, including impacts to 1.83 ha of the threatened ecological community Coastal Upland Swamp in the Sydney Basin Bioregion, listed as endangered under the BC Act and the EPBC Act. The redesign of the planning proposal, to reduce the area of the proposed rezoning and avoid impacts to the Coastal Upland Swamps EEC, particularly the largest and most intact patch of swamp at the western end of the site, have resulted in a reduction in impacts from the previous biocertification boundary (Umwelt 2020). This has resulted in avoidance of 16.95 ha of native vegetation, 7.52 ha of Coastal Upland Swamp EEC and consequent reductions in impacts to a variety of threatened species.

Potential indirect and prescribed impacts from the proposed future development of the proposed rezoning include noise and dust impacts during construction works, the introduction and spread of weed species within and beyond the subject land, and potential impacts to surface and groundwater flows, which have the potential to impact on areas of Coastal Upland Swamp EEC downstream from the subject land. This report identifies a number of measures to mitigate these impacts, including measures to mitigate impacts to hydrological processes and prevent impacts to the Coastal Upland Swamp EEC.

This assessment has also considered impacts to species and communities listed under the EPBC Act (MNES). Three species and one community listed under the EPBC Act, were recorded within the subject land, and a further nine species have potential to occur. The potential impacts to these MNES entities have been assessed, and it is considered likely that the future development of the proposed rezoning will have a significant impact two MNES entities.

Darkinjung is seeking Biocertification for 13.39 ha of the site (the subject land), prior to any future application for subdivision or development. Biodiversity values in the remainder of the site (to be zoned Environmental Conservation) have been considered as part of the conservation measures proposed in this BCAR.

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Appendix A
Threatened species identification

EMM
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BOTANIC GARDENS OF SYDNEY

National Herbarium of New South Wales

Ross DAVEY
EMM Consulting
6/127 Queenscliff Rd
Queenscliff, NSW 2096
AUSTRALIA

BIS Enquiry No: 22490
Botanical.Is@botanicgardens.nsw.gov.au
Ph. No: (02) 4631 5135
Date: 27 March 2024

Dear Ross,

Thank you for your enquiry of 04-Dec-23. We are happy to provide the following information:

Hibbertia procumbens Det. P Jobson 27 March 2024

Prostanthera junonis Det. P Jobson 27 March 2024

We have retained both specimens for the herbarium collection.

Yours sincerely,

Seanna McCune
Identification Senior Technical Officer
Botanical Identification Service

AUSTRALIAN NATIONAL BOTANIC GARDENS

GPO Box 1777
CANBERRA ACT 2601
Telephone: (02) 6250 9530
Facsimile: (02) 6250 9599
http://www.anbg.gov.au
email: anbg-info@anbg.gov.au

24/017

Plant Identification Enquiry Form

Applicant Information

Name: Justin Chey Date submitted: 11-3-2024

Address: Level 3 / 175 Scott St, Newcastle NSW 2300

Telephone: 0466 990 159 ~~Fax:~~

e-mail address: jchey@ennconsulting.com.au

The time taken to complete identifications is subject to the volume of enquiries received and staff availability. Minimum turnaround is 1–2 weeks. Provision of an email address will ensure the fastest response, with a scanned copy of this form attached to our reply. ***Specimens will not generally be returned*** *unless specifically requested via marking the box below.*

Plant Information

Information on how to effectively collect plant specimens for identification is available on request.
For identification of eucalypts, the specimen must include leaves and buds/fruits. A description of the appearance and persistence of the bark is also required.

Location of collection: Somersby, Central Coast, NSW

Description of area where specimen collected: PCT 3593 - Sydney Coastal Sandstone Blackwood Shrub Forest

☐ Tree ☐ Cultivated ☐ Specimen to be returned

☑ Shrub ☐ Wild

☐ Herb/grass/other (please specify):

Height: 30cm Flower colour/s: No flowers, but collected previously present.

Other features/comments: Suspected Hibbertia puberula.

Identification

Scientific Name: Hibbertia puberula Family:

Common Name/s (if any): possibly subsp. extensa

Identified by: Date:

Comments:

Office Use

Enquiry completed by: Our Ref: Date replied:

☐ email ☐ Form posted ☐ Letter ☐ Phone ☐ Fax ☐ Other:

Appendix B
Details for fauna surveys

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B.1 Summary of meteorological conditions during field surveys

Table B.1 Meteorological conditions during field surveys, Gosford AWS NSW 061425

Survey undertaken	Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Wind 9 am (km/h)	Relative humidity 9 am (%)	Wind 3 pm (km/h)	Relative humidity 3 pm (%)
Spotlighting and call playback, habitat assessments (evidence of breeding) and habitat assessments	27/08/2018 – 28/08/2018	9.1–9.9	14.0–14.6	1.8	-	-	-	-
Targeted threatened flora transects	31/10/2018	16.1	26.0	0.0	-	-	-	-
Targeted threatened species transects and targeted threatened flora transects	22/01/2019 – 23/01/2019	20.6–21.1	31.1–31.6	0.2	-	-	-	-
Nocturnal searches, Call-playback, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo), Koala SAT tests, Microhabitat breeding habitat assessment	25/03/2019 – 28/03/2019	13.9–20.0	23.9–25.9	7.4	-	-	-	-
Remote camera	25/03/2019 – 06/05/2019	7.9–20.0	19.3–33.3	88.0	-	-	-	-
Nocturnal searches, Hollow bearing tree analysis, Call-playback, Stag watching, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo)	06/05/2019 – 08/05/2019	6.6–13.8	20.4–23.5	4.6	-	-	-	-
Targeted threatened flora transects	27/11/2019 – 28/11/2019	10.1–11.7	22.0–25.8	11.2	-	-	-	-
Nocturnal searches, Call-playback, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo), Forest owl tree hollow searches, Targeted threatened flora transects	24/03/2020 – 25/03/2020	15.3–15.6	22.1–23.1	12.4	-	-	-	-

Survey undertaken	Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Wind 9 am (km/h)	Relative humidity 9 am (%)	Wind 3 pm (km/h)	Relative humidity 3 pm (%)
Habitat assessments	15/05/2023 – 16/05/2023	10.1	20.2–21.0	4.4		-	-	-
Diurnal bird surveys, Habitat assessment, SATs	19/10/2023	13.1	22.4	0.0	4	72	11	46
Diurnal bird surveys, Habitat assessment, SATs	23/10/2023 – 25/10/2023	9.1–14.0	23.0–27.6	0.0	7–17	41-75	11-19	42-61
Acoustic surveys for microbats, Targeted flora surveys	20/11/2023 – 24/11/2023	16.7–19.2	23.5–26.7	7.0	0–13	69-91	6-20	64-80
Targeted flora surveys	30/11/2023	16.7	28.4	8.0	15	61	19	45
Spotlighting, microbat roost habitat searches, harp trapping	2/01/2024 – 5/01/2024	18.6–21.0	24.4–28.1	4.2	4–15	-	-	-
Giant Dragonfly searches, swamp mapping	29/01/2024 – 30/01/2024	19.5–23.5	29.3–29.4	1.4	6–9	-	-	-
Spotlighting, targeted flora surveys	19/02/2024 – 22/02/2024	18.9–21.6	29.6–23.8	40.6	6–13	-	-	-
SAT surveys	01/03/2024	22.7	28.2	0.0	4	-	-	-
Owl call playback	21/03/2024	15.6	22.0	0.4	11	-	-	-
Owl call playback	02/04/2024	15.1	28.8	0.0	6	-	-	-
Owl call playback	15/04/2024	13.8	25.2	0.0	6	-	-	-

B.2 Surveyor experience

Table B.2 Surveyor experience for fauna surveys

Surveyor	Licences and Ethics Approvals	Fauna Survey	Experience
Jason Brown (Associate Ecologist - EMM)	NSW Scientific Licence: SL100409 Animal Care & ethics Committee, Animal Research Authority (ACEC ARA): 17/964	Frog surveys • Red-crowned Toadlet • Giant Burrowing Frog	Jason is a competent threatened frog surveyor with experience conducting surveys across the North Coast and Sydney regions of NSW. Within the Sydney region, Jason has successfully targeted and recorded Red-crowned Toadlet and Giant Burrowing Frog. Project survey experience: Mona Vale Road Upgrade (Sydney); OMPS (North Coast).
		Reptile surveys • Broad-headed Snake	Jason has conducted numerous surveys focusing on threatened reptiles across NSW. Pale-headed Snake. Spotlighting, funnel trapping – not detected (OMPS) Stephens' Banded Snake. Spotlighting – not detected (OMPS) Project survey experience: OMPS (North Coast).
		Koala surveys	Jason is an experienced koala surveyor, having conducted targeted koala surveys in the North Coast and Blue Mountains regions of NSW. Notably, Jason has successfully targeted and recorded the presence of koalas utilising detection dogs in the North Coast region. Project survey experience: OMPS (North Coast); Lake Lyell (Blue Mountains).
Ireni Clarke (Senior Ecologist - EMM)	NSW Scientific Licence: SL100409 Animal Care & ethics Committee, Animal Research Authority (ACEC ARA): 17/964	Frog surveys • Red-crowned Toadlet • Giant Burrowing Frog	Ireni is proficient in visually and audibly identifying amphibians and has conducted threatened frog surveys on numerous projects across NSW. Notably, Ireni has targeted and recorded Red-crowned Toadlet and Giant Burrowing Frog in the Sydney region and the Tusked Frog in the New England region. Project survey experience: Mona Vale monitoring (Sydney); Mole River, Dungowan, and Sundown Solar (New England).
		Reptile surveys • Broad-headed Snake	Ireni has experience conducting threatened reptile surveys across the New England and Snowy Mountains regions in NSW. Ireni has successfully targeted and recorded Border Thick-tailed Gecko and Alpine She-oak Skink in the New England and Snowy Mountain regions, respectively. Project survey experience: Mole River, Dungowan, and Sundown Solar (New England); Snowy 2.0 (Snowy Mountains).

Surveyor	Licences and Ethics Approvals	Fauna Survey	Experience
		Bat surveys • Large-eared Pied Bat • Eastern Cave Bat	Ireni is proficient in survey methods for threatened bats, i.e. roost habitat searches and harp trapping, and has conducted surveys across the NSW North Coast and New England regions. Notably, she has successfully targeted and recorded Large Bent-winged Bat, Southern Myotis, Corben's Long-eared Bat, and Eastern Cave Bat in the New England region. Within the North Coast region, Ireni has successfully targeted and recorded Eastern False Pipistrelle and Little Bent-winged Bat. Project survey experience: OMPS (North Coast); Mole River and Dungowan (New England).
		Koala surveys	Ireni is a competent koala surveyor with experience conducting targeted koala surveys across the Macarthur and New England regions in NSW. Project survey experience: Upper Canal Koala Crossing and Wilton KPOM (Macarthur); Mole River, Dungowan, and Sundown Solar (New England).
Amy Rowles (Corymbia Ecology)	Refer to CV attached	Bat surveys • Large-eared Pied Bat • Eastern Cave Bat	Refer to CV attached

CORYMBIA ECOLOGY

Amy Rowles

Fauna Ecologist

0418 451 488

amy@corymbiaecology.com.au

415 Parishs Rd, Hilldale, NSW, 2420

ABN 61854031078

Curriculum Vitae
July 2023

Name: Amy Rowles (nee Williams)

Date of Birth: 15th March 1978

Tertiary Education

- B. Sc. (Ecology), Macquarie University 1999
- Hons (First Class) *The Ecology of Insectivorous Bats in the Simpson Desert,* Sydney University 2001.
- PhD Candidate, Hawkesbury Institute of the Environment, Western Sydney University 2019—present. Research topic: *Seasonal Migration of Australian Microbats*

Background

I was fortunate to participate in many mammal surveys as a child and teenager providing me with a solid background for my career as an ecologist. I have gained the most field experience with terrestrial mammals and have a particular interest in bats , with my Honours project studying habitat use, diet and roosting ecology of insectivorous bats in the Simpson Desert. I continuously worked as an ecologist for Ecotone Ecological Consultants on a casual basis from 1996 until 2014. Also during this time I have completed a Bachelor of Science with first class Honours, spent eight years as a voluntary caretaker of a wildlife orphanage and sanctuary as well as working as the administrative assistant for the Ecological Consultants Association of NSW since 2007. I have shared the duties of caring for our four children over the last 18 years. Since 2014 to November 2017, I worked as a Zoologist for Biosis, initially as a casual, then in a permanent position from May 2016. Over the last 28 years I have attended most of the Australasian Bat Society Biannual Conferences. I have gained competent computer skills and the ability to work well as part of a team. I am currently working as sole trader as well as sub-consulting for several consulting companies, while completing a PhD candidature on a part-time basis at Western Sydney University studying the migration of Australian microbats. Recent projects include: assisting EcoLogical with the microbat exclusion at Balickera water tunnel, including exclusion, translocation and radiotracking; assisting Geolink with radiotracking Myotis during a bridge exclusion at Barrington; radio-

tracking cave-roosting bats; radio-tracking Regent Honeyeaters; working as a research assistant on a Sydney University urban bat-box research project.

Professional Experience

PhD Candidate (part-time) **February 2019—Present**

Hawkesbury Institute of the Environment, Western Sydney University

Sole Trader and sub-consultant - Corymbia Ecology **November 2017—Present**

Ecologist

Casual Research Assistant—Sydney University **February 2021– present**

Bat box project Greater Sydney and surrounds

Casual for EMM and Firebird Eco **January 2018 - November 2019**

Zoologist

Biosis Pty Ltd **2014 - November 2017**

Zoologist

Ecotone Ecological Consultants Pty Ltd **1996 - 2014**

Ecologist (Casual)

Consulting experience includes:

- Fauna and flora field surveys
- Targeted threatened fauna survey and assessment
- Assisting with threatened flora surveys
- Assisting with biobanking quadrats
- Literature reviews
- Report writing
- Preparation of proposals and budgets
- Project Management
- Nest-box installation
- Ultrasonic bat call analysis
- Fauna management plans
- Species impact statements
- Review EIS for council
- Preparation of fauna survey guidelines for council
- Basic GIS (Map Info and ArcGIS)
- Word, Publisher, Excel, Access, Photoshop

Examples of Consulting projects include:

- Targeted microbat surveys for Whitehaven Coal (assisting AMBS) Biodiversity Offset monitoring, including *Nyctophilus corbeni* population study 2022-2023
- Roost study using radio-tracking of *Chalinolobus dwyeri* and *Vespadelus troughtoni*

(assisting Ecological Australia) 2023

- Radio-tracking Regent Honeyeaters (assisting Birds Australia), monitoring a captive breeding release 2022-2023
- Balickera water tunnel microbat exclusion project (assisting EcoLogical Australia) 2021
- Barrington Bridge Myotis radiotracking (assisting GeoLink) 2021
- Large-eared Pied Bat Survey (radiotracking to locate maternity roost) 2021
- Targeted Fauna Survey, Snowy Hydro Scheme 2.0. 2018-2019
- Millfield Bridge bat roost monitoring 2002
- Balickera water tunnel micro bat management project 1997-2000, 2017
- Waldalba Squirrel glider nest box monitoring 2007
- Charlestown Road Bypass - owl and squirrel glider nest box monitoring 2007
- Targeted Koala surveys: Central Coast, Grahamstown Dam, Port Macquarie. 1996, 2011, 2013
- Wollongong LGA surveys for OEH (1 week) 2002
- Warragamba Catchment Surveys for OEH 2003-2004
- Targeted fauna surveys in western slopes of NSW 2017
- Coffs Harbour Bypass (Targeted fauna survey and assessment) 2016-2017
- Targeted fauna surveys including Squirrel Glider, Gunnedah 2017
- Targeted fauna surveys, Denman 2016-2017
- Preparation of Fauna Survey Guidelines for Lake Macquarie Council 2012
- Microbat Management Plan, Dover Heights 2019
- Microbat Supplementary Survey, Killcare Heights 2019
- Microbat Survey Millfield Road, Cessnock for Hunter Water 2019

Ecological Consultants Association of NSW 2007 - Present

Administrative Assistant (Casual)

- Manage email traffic and other correspondence
- Membership
- Conference and workshop organisation and registration
- Invoicing and receipts
- Consulting Ecology (ECA biannual journal: collate, design, layout and editing).

Professional Affiliations

- Royal Zoological Society of NSW - member since 1996
- Australasian Bat Society - member since 1996
- Ecological Consultants Association of NSW - Practising Member since 2016
- Ecological Society of Australia—member since 2022

Relevant Courses and Conferences

- Introduction to Map-info
- Fauna Survey Techniques Workshop (Ecological Consultants Association of NSW)
- Anabat bat call analysis (Titley Scientific)
- Fauna Use of Tree Hollows Workshop (Ecological Consultants Association of NSW)

- Identification of Little Brown Birds (Birds Australia)
- Australasian Bat Society Conferences (regular attendance)
- Ecological Consultants Association of NSW annual conferences since 2007
- Camera Trapping Symposium
- Royal Zoological Society annual symposium (regular attendance)
- Threatened Invertebrate Workshop (ECA of NSW Workshop)
- Fungi Workshop (ECA of NSW Workshop)
- Anabat Insight and Call Identification Workshop (2019)
- Introduction to R computer program (September, 2019)

Volunteer Experience

- Trapping and radio-tracking Golden-tipped Bats, November 2020
- Voluntary full-time Caretaker at the Kangaroo Protection Co-operative Sanctuary and Orphanage 2001 - 2009
- Sydney University reptile and small mammal surveys (pit fall trapping) in the Simpson Desert 2000-2001
- Fauna surveys with NPWS / DECCW Western Division 1994 and 1996
- Bush Regenerator 1997
- Wildlife Carer on-going
- Macquarie University Fauna Park 1997-1999
- DPI Microbat Banding Survey Chichester State Forest 2017 and 2018

Accreditations / Licenses / Vaccinations

- Certified Practising Ecological Consultant (Member number 11)
- Scientific License SL102034 (Biodiversity Conservation Act 2016— License to Pick plants for identification. Harm, trap, capture, release animals) (Valid 30/6/23) (currently under renewal).
- Animal Research Authority and Animal Care and Ethics Approval (5 February 2021 to 5 February 2024) (CSB 18/31 (2) Secretary's ACEC Meeting 210 15 March 2021 —issued by DPI)
- A -Class Bat Banding License—ABBBS Banding Authority Number: 9213
- Work Cover OH&S Induction for Construction Industry (White Card)
- First Aid 5/5/21: HLTAID013 - Provide First Aid in remote or isolated site; HLTAID011 - Provide First Aid; HLTAID010 - Provide basic emergency life support; HLTAID009 - Provide cardiopulmonary resuscitation.
- Accredited Tree Climber (TAFE)
- Drivers License Class C (Manual)
- Rabies Vaccine (protection against Bat Lyssa Virus)
- Working at Heights
- Enter and work in confined space
- Rail Industry Worker Card
- 4WD Course

Scientific Publications

Williams A., and Dickman C. (2004) The Ecology of Insectivorous Bats in the Simpson Desert, Central

Australia: Habitat Use. *Australian Mammalogy* **26:** 205-214

Referees

Nathan Garvey
Associate Ecologist
EMM
02 4907 4814
0477 717 010
ngarvey@emmconsulting.com.au

Brian Wilson
(Former director of Ecotone Ecological Consultants)
(02) 4911 4041
0407980961
bwilson452@gmail.com

Paul Burcher
(*Treasurer of Ecological Consultants Association of NSW*)
Aquila Ecological Surveys
94563853 0499777490
paul@aquilaeco.com.au

Appendix C
Biodiversity credit report

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BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00048351/BAAS17058/24/00048352

Proposal Name
Reeves St Somersby Biocertification_FINAL_May2025

BAM data last updated *
28/10/2024

Assessor Name
Ireni Clarke

Assessor Number
BAAS25004

BAM Data version *
Current classification (live - default) (80)

Proponent Names

Report Created
23/05/2025

BAM Case Status
Finalised

Assessment Revision
3

Assessment Type
Biocertification

Date Finalised
23/05/2025

* 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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Coastal Upland Swamp in the Sydney Basin Bioregion	Endangered Ecological Community	3924-Sydney Coastal Upland Swamp Heath

Species
Chalinolobus dwyeri / Large-eared Pied Bat

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Botaurus poiciloptilus / Australasian Bittern
Ixobrychus flavicollis / Black Bittern
Rostratula australis / Australian Painted Snipe

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3586-Northern Sydney Scribbly Gum Woodland	Not a TEC	2.4	50	7	57
3593-Sydney Coastal Sandstone Bloodwood Shrub Forest	Not a TEC	8.7	219	18	237
3807-Northern Sydney Heath-Mallee	Not a TEC	0.4	0	15	15
3924-Sydney Coastal Upland Swamp Heath	Coastal Upland Swamp in the Sydney Basin Bioregion	1.8	0	0	0

3586-Northern Sydney Scribbly Gum Woodland

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1681, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598	Sydney Coastal Dry Sclerophyll Forests <50%	3586_High	Yes	50	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1681, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598	Sydney Coastal Dry Sclerophyll Forests <50%	3586_Open	No	7	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3593-Sydney Coastal Sandstone Bloodwood Shrub Forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1681, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598	Sydney Coastal Dry Sclerophyll Forests <50%	3593_High	Yes	219	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1681, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598	Sydney Coastal Dry Sclerophyll Forests <50%	3593_Disturbed	No	4	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1681, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598	Sydney Coastal Dry Sclerophyll Forests <50%	3593_Pines	No	14	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3807-Northern Sydney Heath-Mallee	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	Sydney Coastal Heaths This includes PCT's: 3807, 3808, 3809, 3810, 3811, 3812, 3813, 3814, 4127	Sydney Coastal Heaths <50%	3807_High	No	15	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3924-Sydney Coastal Upland Swamp Heath	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Coastal Upland Swamp in the Sydney Basin Bioregion This includes PCT's: 3896, 3923, 3924, 3925, 3949	-	3924_High	Yes	0	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	**3586_Open, 3586_High, 3593_High, 3807_High, 3924_High, 3593_Disturbed, 3593_Pines**	13.3	423.00
Chalinolobus dwyeri / Large-eared Pied Bat	**3586_Open, 3586_High, 3593_High, 3924_High, 3593_Disturbed, 3593_Pines**	12.9	602.00
Heleioporus australiacus / Giant Burrowing Frog	**3586_Open, 3586_High, 3593_High, 3807_High, 3924_High, 3593_Disturbed, 3593_Pines**	13.3	317.00
Hibbertia procumbens / Spreading Guinea Flower	**3586_Open, 3586_High, 3593_High, 3807_High, 3924_High, 3593_Disturbed, 3593_Pines**	13.3	423.00
Hibbertia puberula / Hibbertia puberula	**3593_High, 3593_Disturbed, 3593_Pines**	8.7	315.00
Petaurus norfolcensis / Squirrel Glider	**3586_Open, 3586_High, 3593_High, 3807_High, 3924_High, 3593_Disturbed, 3593_Pines**	13.3	423.00

Pseudophryne australis / Red-crowned Toadlet	**3586_Open, 3586_High, 3593_High, 3807_High, 3924_High, 3593_Disturbed, 3593_Pines**	13.3	317.00

Credit Retirement Options

Like-for-like credit retirement options

Cercartetus nanus / Eastern Pygmy-possum	Spp	IBRA subregion
	Cercartetus nanus / Eastern Pygmy-possum	Any in NSW
Chalinolobus dwyeri / Large-eared Pied Bat	Spp	IBRA subregion
	Chalinolobus dwyeri / Large-eared Pied Bat	Any in NSW
Heleioporus australiacus / Giant Burrowing Frog	Spp	IBRA subregion
	Heleioporus australiacus / Giant Burrowing Frog	Any in NSW
Hibbertia procumbens / Spreading Guinea Flower	Spp	IBRA subregion
	Hibbertia procumbens / Spreading Guinea Flower	Any in NSW
Hibbertia puberula / Hibbertia puberula	Spp	IBRA subregion
	Hibbertia puberula / Hibbertia puberula	Any in NSW

Petaurus norfolcensis / Squirrel Glider	Spp	IBRA subregion
	Petaurus norfolcensis / Squirrel Glider	Any in NSW
Pseudophryne australis / Red-crowned Toadlet	Spp	IBRA subregion
	Pseudophryne australis / Red-crowned Toadlet	Any in NSW

Appendix D

Likelihood of occurrence assessment

EMM
creating opportunities

D.1 Threatened ecological communities

Table D.1 Likelihood of occurrence for threatened ecological communities

Ecological community	EPBC Status	Habitat requirements	Likelihood of occurrence	Justification
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	E	The ecological community occurs in coastal catchments, mostly at elevations of less than 20 m above sea-level (ASL) that are typically found within 30 km of the coast. Coastal Swamp Oak Forest typically occurs on unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea-level rise during the Holocene period (Sloss et al., 2007). These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils). The ecological community can also occur on organosols (peaty soils). Occurrences of swamp oak trees on rocky headlands or other consolidated substrates are not considered to be a part of the ecological community, but areas where soils transition into unconsolidated sediments may contain the ecological community. The ecological community is typically found where groundwater is saline or brackish, but can occur in areas where groundwater is relatively fresh. It is typically found on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated.	Low	This TEC occurs in low lying areas that are frequently inundated, on unconsolidated sediments in floodplains. The study area does not meet this description.
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	E	"The ecological community most commonly occurs at elevations below 20m above sea-level (ASL) but may occur occasionally up to 220m ASL on hill slopes, for example in association with perched swamps and lakes, or a naturally high-water table.	Low	This TEC occurs in low lying coastal areas that are periodically inundated, with a canopy dominated by melaleuca species and Swamp Mahogany. The study area does not meet this description.
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CE	The frequency and duration of water inundation, salinity and nutrient content of the soil, and latitude influences the vegetation composition of the Coastal Swamp Sclerophyll Forest. The ecological community is found on hydric soils, which are either waterlogged or intermittently or episodically inundated for typically between one to three months per year, often seasonally.	Low	TEC occurs on alluvial floodplains, usually at low elevations. The site does not occur in a suitable position in the landscape to support this community.
Coastal Upland Swamps in the Sydney Basin Bioregion	E	The Coastal Swamp Sclerophyll Forest typically features acanopy and/or sub-canopy dominated by Melaleuca spp. and/or Eucalyptus robusta. Other eucalypts, which are also tolerant of regular inundation and are adapted to sandy soils, may emerge from the canopy with the mix of species presentvarying depending on the location."	Known	This TEC has been recorded on site, associated with PCT 3924. The study area contains suitable heath, sedge and scrub habitat and is on the Hawkesbury sandstone plateau.

D.2 Threatened species

Table D.2 Likelihood of occurrence for EPBC listed species

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Plants					
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	V	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable dry sclerophyll forest on sandy soils, including Red Bloodwood (Corymbia gummifera) and Scribbly Gum (Eucalyptus haemastoma).
Asterolasia elegans		E	Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine, Smooth-barked Apple, Sydney Peppermint, Forest Oak and Christmas Bush. Ecological knowledge about this species is very limited. The species is considered to be fire sensitive and reliant on seed germination after disturbance to maintain populations.	Low	The study area is not positioned on a lower slopes, valley or gulley. The site does not contain sheltered forest, although there are Smooth-barked Apple present. No records are present in the vicinity.
Baloskion longipes	Dense Cord-rush	V	Commonly found in swamps or depressions in sandy alluvium, sometimes growing with sphagnum moss. Also occurs in swails within tall forest, and in Black Gum Woodland. Produces new shoots from underground stems (rhizomes), but little is known about its biology.	Low	There is no alluvial or Black Gum woodland habitat present in the study area, and the study area is outside of the species distribution, as the species occurs south and west of Sydney.
Caladenia tessellata	Thick-lipped Spider-orchid, Daddy Long-legs	V	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations).	Low	The study area contains some marginal woodland habitat, however the species was not recorded during targeted flora surveys, and the only records in the region are historic.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Cryptostylis hunteriana	Leafless Tongue-orchid	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum, Silvertop Ash, Red Bloodwood and Black Sheoak; appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid and the Tartan Tongue Orchid. Little is known about the ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site. On the Central Coast of NSW, populations have been recorded in woodland dominated by Scribbly Gum (Eucalyptus haemastoma), Brown Stringybark (Eucalyptus capitellata), Red Bloodwood (Corymbia gummifera) and also associated with Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta).	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable swamp heath and woodland habitat.
Cynanchum elegans	White-flowered Wax Plant	E	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree,Coastal Banksia, coastal scrub; Forest Red Gum, aligned open forest and woodland; Spotted Gum aligned open forest and woodland; and Bracelet Honeymyrtle scrub to open scrub.	Low	The study area does not contain vegetation types associated with the species, and there are no records in the vicinity.
Eucalyptus camfieldii	Camfield's Stringybark	V	Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of Narrow-leaved Stringybark, Brown Stringybark and Scribbly Gum. Population sizes are difficult to estimate because its extensive lignotubers may be 20 m across. A number of stems arise from these lignotubers giving the impression of individual plants. Flowering period is irregular, flowers recorded throughout the year. Poor response to too frequent fires.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable coastal heath, with sandy soils overlying Hawkesbury sandstone.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Genoplesium baueri	Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid	E	Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable dry sclerophyll forest on sandstone.
Grevillea shiressii	-	V	Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils. Flowers mainly late winter to Spring (July-December), with seed released at maturity in October. Flowers are bird pollinated and seeds are dispersed by ants. A fire sensitive obligate seeder that is highly susceptible to local extinction due to frequent fire, however, fire is likely to be relatively infrequent in the habitat of G. shiressii. Seed germination does occur in the absence of fire, however some physical disturbance is likely to promote seed germination.	Negligible	This species was surveyed and not recorded in the study area. The study area contains marginal habitat for this species, although lacks wet sclerophyll.
Haloragis exalata subsp. *exalata*	Wingless Raspwort, Square Raspwort	V	Square Raspwort appears to require protected and shaded damp situations in riparian habitats. Flowering specimens in NSW are recorded from November to January.	Low	The study area does not contain any suitable riparian habitats and is outside of the species distribution. There are no records in the vicinity.
Lasiopetalum joyceae	-	V	Grows in heath on sandstone.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable heath habitat on sandstone.
Melaleuca biconvexa	Biconvex Paperbark	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October. Resprouts following fire.	Moderate	There is some suitable damp habitat in low-lying areas of the study area, and records in the vicinity.
Melaleuca deanei	Deane's Melaleuca	V	The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable woodland habitat and heath on sandstone habitat.
Micromyrtus blakelyi	-	V	Typically occurs within heathlands in shallow sandy soil in cracks and depressions of sandstone rock platforms. Flowers in Spring from September to November and produces fruit (an indehiscent nut) October to November. Fire sensitive, with adults killed by fire and recruitment occurring from a soil seed bank. It is not known whether germination occurs in the absence of disturbance.	Negligible	This species was surveyed and not recorded in the study area. The study area contains areas of shallow sandy soils with heathland on rock platforms and outcrops.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	The Hairy Geebung is found in clayey and sandy soils in dry sclerophyll open forest, woodland and heath, primarily on the Mittagong Formation and on the upper Hawkesbury Sandstone. It is usually present as isolated individuals or very small populations. Plants are generally killed by all but the lowest intensity fire or partial burning. Fire may promote germination of soil-stored seed, although it may also kill some of the seedbank if it is of high severity. Extreme wet-dry weather cycles may also promote germination of soil-stored seed.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable heath and woodland habitat, on Hawkesbury sandstone.
Pimelea curviflora var. *curviflora*	-	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowalnd Grassy Woodland habitat at Albion Park on the Illawaraa coastal plain. Flowers October to May. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots. Likely to be fire tolerant species capable of resprouting following fire due to the presence of a tap root. Seedlings have been observed following fire.	Low	This species occurs in areas with shale derived soils, which are not present in the study area.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Prostanthera askania	Tranquillity Mintbush, Tranquility Mintbush	E	Occurs adjacent to, but not immediately in, drainage lines on flat to moderately steep slopes formed on Narrabeen sandstone and alluvial soils derived from it. Occurs in moist sclerophyll forest and warm temperate rainforest communities, and the ecotone between them. These communities are generally tall forests with a mesic understorey; Sydney Blue Gum and Turpentine are usually present, though canopy species present can be highly variable. Ecological knowledge about this species is very limited. The species is likely to be fire-sensitive given the moist forest habitats it occupies, however, its fire ecology is currently unknown. May be a colonising species that takes advantage of increased light following natural canopy-cover disturbance. May be out competed by invading weed species such as Lantana. Appears in some locations to propagate vegetatively by 'stem-layering' where prostrate branches take root where they remain in contact with the soil. This characteristic and the species' tendency at many sites to form dense clumps make accurate counting of individual plants within populations difficult.	Low	The study area lacks the moist sclerophyll forest and warm temperate rainforest communities that this species prefers, although the study area is within the geographic constraints for the species.
Prostanthera junonis	Somersby Mintbush	E	The species is restricted to the Somersby Plateau. It occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub. It occurs in both disturbed and undisturbed sites. The dominant flowering period for this species is October to mid-December depending on weather/site conditions. The plant is very difficult to identify outside of this time. While mature plants appear to be incapable of resprouting after fire, it may trigger seed germination.	High	The species was recorded on site during targeted surveys, but not within the subject land. The subject land contains suitable woodland and scrub habitat for the species.
Rhizanthella slateri	Eastern Underground Orchid	E	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. Flowers September to November.	Negligible	This species was surveyed and not recorded in the study area. The study area contains potentially suitable sclerophyll forest for the species.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Rhodamnia rubescens	Scrub Turpentine, Brown Malletwood	CE	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	Low	The study area lacks the wet sclerophyll forest and warm temperate rainforest communities that this species prefers.
Rhodomyrtus psidioides	Native Guava	CE	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	Low	The study area lacks the wet sclerophyll forest and warm temperate and subtropical rainforest communities that this species prefers.
Rutidosis heterogama	Heath Wrinklewort	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Moderate	The study area contains some suitable heath habitat, but there are no records in the vicinity and the species was not observed during targeted flora surveys.
Syzygium paniculatum	Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry	V	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low	The study area does not contain suitable littoral rainforest habitat to support this species.
Thesium australe	Austral Toadflax, Toadflax	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Low	Study area does not contain grassland or grassy woodland habitat to support the species. No Themeda species were recorded within mapped PCTs, and there are no records in the vicinity.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Birds					
Anthochaera phrygia	Regent Honeyeater	CE	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. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast. In the last 10 years Regent Honeyeaters have been recorded in urban areas around Albury where woodlands tree species such as Mugga Ironbark and Yellow Box were planted 20 years ago. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. Other tree species may be regionally important. For example the Lower Hunter Spotted Gum forests have recently been demonstrated to support regular breeding events.	Low	Study area does not contain preferred habitat of Box-Ironbark woodland, riparian forests of River Sheoak or coastal Swamp Mahogany or Spotted Gum forests. Recorded 3km away in 2022.
Botaurus poiciloptilus	Australasian Bittern	E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes. Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds; there are usually six olive-brown eggs to a clutch.	Low	The study area does not contain any wetland habitat to support this species.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Calidris acuminata	Sharp-tailed Sandpiper	V	Species occurs in muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry	Low	There is no suitable wetland habitat with standing water in the study area that would support the species.
Calidris canutus	Red Knot, Knot	V	In NSW the Red Knot mainly occurs in small numbers on intertidal mudflats, estuaries, bays, inlets, lagoons, harbours and sandflats and sandy beaches of sheltered coasts. It is occasionally found on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms and is a rare visitor to terrestrial saline wetlands and freshwater swamps. It usually forages near the water's edge, with feeding activity regulated by the tide as birds closely follow the tide-edge. The diet consists of worms, bivalves, gastropods, crustaceans and echinoderms. The birds roost on sandy beaches, spits, islets and mudflats close to feeding grounds, usually in open areas.It is rarely found on inland lakes or swamps.	Low	There is no suitable wetland habitat for the species in the study area, such as mudflats, estuaries, lagoons or sandflats.
Calidris ferruginea	Curlew Sandpiper	CE	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 inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores. Curlew Sandpipers are omnivorous, feeding on worms, molluscs, crustaceans, insects and some seeds.	Low	There is no suitable wetland habitat within the study area that would support the species.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Callocephalon fimbriatum	Gang-gang Cockatoo	E	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands,particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 7 cm in diameter or larger in eucalypts and 3 metres or more above the ground.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable foraging habitat, with some potential breeding hollows present.
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	South-eastern glossy black cockatoos feed almost exclusively on the seeds of sheoaks (Allocasuarina spp. and Casuarina spp.), usually relying on one or two species within a region	Known	Species has been recorded on site. Suitable habitat is present, including Black She-oak (Allocasuarina littoralis) in PCTs 3586, 3593 and 3807.
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	V	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders. Diet includes insects, crustaceans, polychaete worms and molluscs.	Low	There is no suitable wetland habitat within the study area that would support the species.
Climacteris picumnus victoriae	Brown Treecreeper (south-eastern)	V	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 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.	Low	The species prefers dryer, more open woodland habitats with rough-barked eucalypts, which are not present in the study area. The species is uncommon east of the Great Dividing Range.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Erythrotriorchis radiatus	Red Goshawk	E	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	Low	None of the preferred NSW habitats are present on the site: mixed subtropical rainforest, Melaleuca swamp forest or riparian Eucalyptus forest of coastal rivers. There are no records within the vicinity.
Falco hypoleucos	Grey Falcon	V	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. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring; two or three eggs are laid.	Low	The study area does not contain suitable hbaitat for the species, which usually occurs in shrubland, grassland or wooded watercourses of arid and semi-arid regions. There are no sightings in the vicinity.
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	V	Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level . They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters, but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains. The structure and composition of the vegetation that occurs around these wetlands is not important in determining the suitability of habitat . As such, snipe may be found in a variety of vegetation types or communities including tussock grasslands with rushes, reeds and sedges, coastal and alpine heathlands, lignum or tea-tree scrub, button-grass plains, alpine herbfields and open forest	Low	The study area contains no permanent or ephemeral wetlands that might support this species.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Grantiella picta	Painted Honeyeater	V	Inhabits Boree/ Weeping Myall, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Low	The study area does not contain suitable Weeping Myall, Brigalow, Box-Gum Woodlands or Box-Ironbark Forests.
Hirundapus caudacutus	White-throated Needletail	V, Mi	Recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. White-throated Needletails almost always forage aerially, at heights up to 'cloud level', above a wide variety of habitats ranging from heavily treed forests to open habitats, such as farmland, heathland or mudflats.	High	Suitable heathland and wooded habitat is found in the study area. There have been recent sightings in the vicinity.
Lathamus discolor	Swift Parrot	CE	Migrates to the Australian south-east mainland between February and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Forest Red Gum, Mugga Ironbark, and White Box. Commonly used lerp infested trees include Inland Grey Box, Grey Box, Blackbutt, and Yellow Box. Return to some foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum.	Moderate	Study area is outside the mapped important areas for this species. Sightings have been recorded in the vicinity, and Red Bloodwood is found in the study area (a preferred feed tree).
Melanodryas cucullata cucullata	South-eastern Hooded Robin, Hooded Robin (south-eastern)	E	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.	Low	Although the study area contains woodland habitat, the species generally prefers drier habitats in open eucalypt woodland with a grass ground layer. There are no sightings in the vicinity.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Neophema chrysostoma	Blue-winged Parrot	V	Blue-winged parrots inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones. Nests are made in hollows, preferably with a vertical opening, in live or dead trees or stumps. Wetlands both near the coast and in semi-arid zones used for foraging and staging.	Low	Study area contains no wetlands, grasslands or grassy woodlands that would provide suitable habitat for the species. No sightings have been recorded in the vicinity.
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CE	Species generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. May also roost on wooden oyster leases or other similar structures. The Eastern Curlew is carnivorous, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects.	Low	The study area does not contain the preferred habitat of coastal lakes, inlets, bays and estuarine habitats, or intertidal mudflats and saltmarsh of sheltered coasts.
Pycnoptilus floccosus	Pilotbird	V	Pilotbirds are strictly terrestrial, living on the ground in dense forests with heavy undergrowth. Largely sedentary, they are typically seen hopping briskly over the forest floor and foraging on damp ground or among leaf-litter. Habitat critical to the survival of Pilotbirds are wet sclerophyll forests in temperate zones in moist gullies with dense undergrowth, and dry sclerophyll forests and woodlands occupying dry slopes and ridges.	Low	The species prefers dense forest habitats, such as wet sclerophyll in moist gullies with a dense understorey. There are no records in the vicinity.
Rostratula australis	Australian Painted Snipe	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Incubation and care of young is all undertaken by the male only. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Low	The upland swamps on site do not contain any standing water or marshy areas that would provide habitat for the species. There are no records in the vicinity.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Stagonopleura guttata	Diamond Firetail	V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Usually encountered in flocks of between 5 to 40 birds, occasionally more. Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	Low	Study area does not contain suitable grassy woodland habitat. There are no records in the vicinity.
Tringa nebularia	Common Greenshank, Greenshank	E	The species has been recorded in most coastal regions. It is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions. The species is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water often among pneumatophores of mangroves or other sparse, emergent or fringing vegetation, such as sedges or saltmarsh. The Common Greenshank roosts and loafs round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets. Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats.	Low	There is no suitable wetland habitat in the study area, such as mudflats, mangroves, or marshes.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Mammals					
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	E	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, 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 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy. Likely to hibernate through the coolest months. It is uncertain whether mating occurs early in winter or in spring.	Known	Species detected during acoustic surveys. Although the species was not recorded breeding on site, there is potential for suitable breeding habitat to occur within 2 km of the study area, in Strickland State Forest, and the study area contains suitable open woodland habitat.
*Dasyurus maculatus maculatus (*SE mainland population*)*	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	E	Has a preference for mature wet forest habitat, especially in areas with rainfall 600 mm/year. Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable. Habitat requirements include suitable den sites such as hollow logs, tree hollows, rock outcrops or caves. Individuals also require an abundance of food, such as birds and small mammals, and large areas of relatively intact vegetation through which to forage.	High	The study area is connected to large areas of intact vegetation. There is no wet forest habitat in study area, but there have been sightings in the vicinity. Fallen timber and logs for den habitat are present in study area.
Notamacropus parma	Parma Wallaby	V	The optimum habitat for the Parma wallaby is wet sclerophyll forest with a thick, shrubby understorey and nearby grassy patches. The species also occurs in dry sclerophyll forest with a dense understorey and occasionally in rainforest.	Negligible	This species was surveyed and not recorded in the study area. Dry sclerophyll habitat with a dense understory is found in the study area, which is marginal habitat for the species.
Petauroides volans	Greater Glider (southern and central)	E	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha. Give birth to a single young in late autumn or early winter which remains in the pouch for approximately 4 months and is independent at 9 months of age. Usually solitary, though mated pairs and offspring will share a den during the breeding season and until the young are independent. Can glide up to a horizontal distance of 100m including changes of direction of as much as 90 degrees. Very loyal to their territory.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable woodland habitat for this species.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Petaurus australis australis	Yellow-bellied Glider (south-eastern)	V	The yellow-bellied glider (south-eastern) occurs in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests. Abundance is highly dependent on habitat suitability, which is in turn determined by forest age and floristics. The subspecies shows a preference for large patches of mature old growth forest that provide suitable trees for foraging and shelter. There is also a clear preference for forests with a high proportion of winter-flowering and smooth-barked eucalypts. Hollow-bearing trees used by the yellow-bellied glider (south-eastern) are primarily living, smooth-barked eucalypts of multiple species.	High	The study area contains suitable potential habitat of eucalypt dominated woodland. There are existing records in the vicinity.
Petrogale penicillata	Brush-tailed Rock-wallaby	V	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Highly territorial and have strong site fidelity with an average home range size of about 15 ha. Males tend to have larger home ranges than females. The home range consists of a refuge area and a foraging range linked by habitually used commuting routes. Females settle in or near their mother's range, while males mainly disperse between female groups within colonies, and less commonly between colonies.	Low	The study area does not contain suitable rocky escarpments, outcrops, or cliffs that would provide habitat for the species. There are no records within the vicinity.
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	E	Inhabit eucalypt woodlands and forests. 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. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. The majority of koalas in New South Wales are found in forests and subhumid woodlands on the central and north coast , and to the west across the Western Plains and slopes, within Pilliga forest, low woodland and forested areas.	Negligible	This species was surveyed and not recorded in the study area. The study area contains suitable eucalypt woodland habitat for Koalas, including Koala use trees identified for the Central Coast, including Red Bloodwood (Corymbia gummifera), Blue-leaved Stringybark (Eucalyptus agglomerata), Broad-leaved Scribbly Gum (Eucalyptus haemastoma), and Silvertop Ash (Eucalyptus sieberi).

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Potorous tridactylus tridactylus	Long-nosed Potoroo (northern)	V	The Long-nosed Potoroo (SE Mainland) is sparsely distributed along the coast and Great Dividing Range of south-east Queensland through NSW. There is no consistent pattern to the habitat of the Long-nosed Potoroo (SE Mainland); it can be found in wet eucalypt forests to coastal heaths and scrubs . The main factors would appear to be access to some form of dense vegetation for shelter and the presence of an abundant supply of fungi for food. In low altitude and coastal habitats, the northern long-nosed potoroo occurs in Eucalyptus signata (scribbly gum) woodlands with a heathy understory. Habitat size is important, as the long-nosed potoroo rarely occurs in remnant vegetation patches smaller than 0.1 km2. Some occurrences are in habitats 0.16–0.40 km2, most are in habitats 0.41–1 km2, suggesting a minimum patch size of 0.41 km2 is needed to support a subpopulation of long-nosed potoroo.	Negligible	This species was surveyed and not recorded in the study area. The study area contains potential heath and woodland habitat for this species.
Pseudomys novaehollandiae	New Holland Mouse, Pookila	V	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals. Distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	Moderate	There is some potential woodland habitat in the study area. Only historic records exist in the vicinity.
Pteropus poliocephalus	Grey-headed Flying-fox	V	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. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	High	There are no breeding camps within the study area. Study area contains potential foraging habitat, and there are records of the species in the vicinity.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Amphibians					
Heleioporus australiacus	Giant Burrowing Frog	V	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size. Individuals move into the breeding site either immediately before or following heavy rain and occupy these sites for up to 10 days. Most individuals will not attempt to breed every year. The Giant Burrowing Frog has a generalist diet and studies to date indicate that they eat mainly invertebrates including ants, beetles, cockroaches, spiders, centipedes and scorpions. When breeding, frogs will call from open spaces, under vegetation or rocks or from within burrows in the creek bank. Males show strong territoriality at breeding sites. This species breeds mainly in autumn, but has been recorded calling throughout the year. Egg masses are foamy with an average of approximately 500-800 eggs and are laid in burrows or under vegetation in small pools. After rains, tadpoles are washed into larger pools where they complete their development in ponds or ponded areas of the creekline. Tadpole development ranges from around 12 weeks duration to up to 12 months with late developing tadpoles overwintering and completing development when warmer temperatures return. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. This frog is a slow growing and long-lived species, living up to 10 years of age, possibly longer.	Known	Species has been recorded on site. The study area contains suitable heath and woodland habitat, including waterways and swamps with potential breeding habitat.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Litoria littlejohni	Northern Heath Frog, Littlejohn's Tree Frog	E	This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground. Breeding is triggered by heavy rain and can potentially occur all year, but is usually from late summer to early spring when conditions are favourable. Males call from low vegetation close to slow flowing pools. Eggs are laid in loose gelatinous masses attached to small submerged twigs. Eggs and tadpoles are mostly found in still or slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools.	Moderate	Perched swamp habitat is present in the study area, but without any flowing water or streams. Species was not detected during other frog surveys.
Litoria aurea	Green and Golden Bell Frog	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes or spikerushes. Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet. Males call while floating in water and females produce a raft of eggs that initially float before settling to the bottom, often amongst vegetation.	Low	The study area lacks any suitable waterbodies with emergent vegetation, such as marshes, dams or streams, that would support this species.
Mixophyes balbus	Stuttering Frog, Southern Barred Frog (in Victoria)	V	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Feed on insects and smaller frogs. Breed in streams during summer after heavy rain. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.;5|As the tadpoles grow they move to deep permanent pools and take approximately 12 months to metamorphose.;6|	Low	The study area does not contain any watercourses to provide suitable breeding habitat for this species. The species prefers rainforest and wet sclerophyll habitats that are not present within the study area.

Scientific name	Common name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Mixophyes iteratus	Giant Barred Frog, Southern Barred Frog	V	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor. However, Giant Barred Frogs will also sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants, and even occasionally around dams. Although generally found within about 20m of the stream, outside the breeding season, the Giant Barred Frog may disperse away from the stream (e.g. 50m or further).	Low	The study area does not contain any suitable riparian habitat for this species. The species prefers rainforest and wet sclerophyll habitats that are not present within the study area.
Reptiles					
Hoplocephalus bungaroides	Broad-headed Snake	E	Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer. Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally. Females produce four to 12 live young from January to March, which is a relatively low level of fecundity.	Negligible	This species was surveyed and not recorded in the study area. There are some areas of rocky habitat within the study area. Generally, these areas lack exfoliating rock required by the species.
Fish					
Prototroctes maraena	Australian Grayling	V	The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones	Negligible	There are no watercourses within the study area with pools or flowing water that would support this species.
Macquaria australasica	Macquarie Perch	E	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. The eastern form is confined to the Hawkesbury-Nepean and Shoalhaven river systems including a number of Sydney's water supply reservoirs	Negligible	There are no watercourses within the study area with pools or flowing water that would support this species.

D.3 Migratory species

Table D.3 Likelihood of occurrence for migratory species

Scientific Name	Common Name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Migratory Marine Birds					
Apus pacificus	Fork-tailed Swift	Mi	In Australia, the Fork-tailed Swift is almost exclusively aerial, mostly occurring over inland plains but sometimes above foothills or in coastal areas. This species can also occur over cliffs, beaches, treeless grassland and plains covered with spinifex, open farmland and inland and coastal sand-dunes. The species breeds in Asia but migrates to Australia from September to April. Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 m high.	Low	This is an aerial species, usually flying over inland plains and only occasionally in coastal areas. It is unlikely to use the habitat in the study area.
Anous stolidus	Common Noddy	Mi	These species are all entirely marine-based.	Negligible	The study area is approximately 13km from the coast and does not contain any marine habitat.
Ardenna grisea	Sooty Shearwater	Mi			
Calonectris leucomelas	Streaked Shearwater	Mi			
Diomedea antipodensis	Antipodean Albatross	Mi, V			
Diomedea epomophora	Southern Royal Albatross	Mi, V			
Diomedea exulans	Wandering Albatross	Mi, V			
Diomedea sanfordi	Northern Royal Albatross	Mi, E			
Fregata ariel	Lesser Frigatebird, Least Frigatebird	Mi			
Fregata minor	Great Frigatebird, Greater Frigatebird	Mi			
Macronectes giganteus	Southern Giant-Petrel, Southern Giant Petrel	Mi, E			
Macronectes halli	Northern Giant Petrel	Mi, V			

Scientific Name	Common Name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Phaethon lepturus	White-tailed Tropicbird	Mi			
Thalassarche bulleri	Buller's Albatross, Pacific Albatross	Mi, V			
Thalassarche cauta	Shy Albatross	Mi, E			
Thalassarche eremita	Chatham Albatross	Mi, E			
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	Mi, V			
Thalassarche melanophris	Black-browed Albatross	Mi, V			
Thalassarche salvini	Salvin's Albatross	Mi, V			
Thalassarche steadi	White-capped Albatross	Mi, V			
Migratory marine species					
Caretta caretta	Loggerhead Turtle	Mi, E	These species are all entirely marine-based.	Negligible	The study area is approximately 13km from the coast and does not contain any marine habitat.
Chelonia mydas	Green Turtle	Mi, V			
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	Mi, E			
Dugong dugon	Dugong	Mi			
Eretmochelys imbricata	Hawksbill Turtle	Mi, V			
Lamna nasus	Porbeagle, Mackerel Shark	Mi			
Mobula alfredi	Reef Manta Ray, Coastal Manta Ray	Mi			
Mobula birostris	Giant Manta Ray	Mi			
Natator depressus	Flatback Turtle	Mi, V			

Scientific Name	Common Name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Migratory terrestrial species					
Cuculus optatus	Oriental Cuckoo, Horsfield's Cuckoo	Mi	The species has a large breeding range in northern Eurasia. It breeds across much of Russia west to the Komi Republic with occasional records as far west as Saint Petersburg. It also breeds in northern Kazakhstan, Mongolia, northern China, Korea and Japan. The exact extent of its wintering range is uncertain but is believed to include the Malay Peninsula, Indonesia, the Philippines, New Guinea, western Micronesia, the Solomon Islands and northern and eastern Australia with occasional birds reaching New Zealand. It mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	Low	Although the study area contains some marginal woodland habitat that the species may use occasionally during its non-breeding season, the species prefers moist habitats like rainforest and wet sclerophyll.
Hirundapus caudacutus	White-throated Needletail	Mi, V	Recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. White-throated Needletails almost always forage aerially, at heights up to 'cloud level', above a wide variety of habitats ranging from heavily treed forests to open habitats, such as farmland, heathland or mudflats.	High	Suitable heathland and wooded habitat is found in the study area. There have been recent sightings in the vicinity.
Monarcha melanopsis	Black-faced Monarch	Mi	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland.	Low	The species migrates to the south of it's range for breeding in summer. The study area lacks the temperate rainforest habitat the specis requires for breeding.

Scientific Name	Common Name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Motacilla flava	Yellow Wagtail	Mi	This species occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra. The species breeds in the arctic tundra, and migrates to grassy waterside habitats in Southeast Asia over winter.	Low	Although there is some marginal habitat for the species on the site, the species prefers waterside habitat. During the non-breeding season, the species is more likely to be found in South east Asia and northern Australia, rather than in south-east Australia.
Myiagra cyanoleuca	Satin Flycatcher	Mi	The Satin Flycatcher is widespread in eastern Australia and vagrant to New Zealand. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	Low	Prefer heavily vegetated gully habitat in forests and taller woodlands. Unlikely to use the habitat on site, although it may pass through during migration.
Rhipidura rufifrons	Rufous Fantail	Mi	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. The species mainly inhabits wet sclerophyll forests often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt. During migration it can stray into gardens and more open areas.	Low	The study area lacks the wet sclerophyll habitats and forested gullies preferred by the species.
Symposiachrus trivirgatus	Spectacled Monarch	Mi	This species is found in Australia, Indonesia, and Papua New Guinea. Its natural habitats are subtropical or tropical moist lowland forests, subtropical or tropical mangrove forests, and subtropical or tropical moist montane forests.	Low	The study area lacks the moist forest or mangrove habitat that the species prefers.

Scientific Name	Common Name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Migratory wetlands species					
Pandion haliaetus	Osprey	Mi	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes.	Low	The study area lacks any suitable waterbodies or coastal habitat to support this species.
Actitis hypoleucos	Common Sandpiper	Mi	These species all depend on wetland habitat.	Negligible	The study area does not support any suitable wetland habitat or areas of standing water.
Calidris acuminata	Sharp-tailed Sandpiper	Mi			
Calidris canutus	Red Knot, Knot	Mi, E			
Calidris ferruginea	Curlew Sandpiper	Mi, CE			
Calidris melanotos	Pectoral Sandpiper	Mi			
Charadrius bicinctus	Double-banded Plover	Mi			
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Mi, V			
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Mi			
Gallinago megala	Swinhoe's Snipe	Mi			
Gallinago stenura	Pin-tailed Snipe	Mi			
Limosa lapponica	Bar-tailed Godwit	Mi			
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Mi, CE			
Numenius minutus	Little Curlew, Little Whimbrel	Mi			
Numenius phaeopus	Whimbrel	Mi			

Scientific Name	Common Name	EPBC Status[1]	Habitat requirements	Likelihood of occurrence	Justification
Pluvialis fulva	Pacific Golden Plover	Mi			
Tringa brevipes	Grey-tailed Tattler	Mi			
Tringa nebularia	Common Greenshank, Greenshank	Mi			

Appendix E

EPBC Act Assessments of Significance

EMM
creating opportunities

The below assessments are completed in accordance with the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DEWHA 2013), to determine if the proposed rezoning is likely to have a 'significant impact' on MNES.

A 'significant impact' is defined as "an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts" (DEWHA 2013).

E.1 Vulnerable species

E.1.1 Birds

Table E.1 Assessment of significance for Glossy Black Cockatoo and White Throated Needletail

Criteria	Discussion
1. Long-term decrease of an important population	In accordance with the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DEWHA 2013), an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species' range. The South-eastern Glossy Black Cockatoo (hereafter referred to as Glossy Black Cockatoo) occurs as a single population north from Mitchell, Queensland through eastern New South Wales to East Gippsland, with more scattered occurrences inland as far west as the NSW Riverina (DCCEEW 2022). The White-throated Needletail is a migratory species that exists as a series of interconnected subpopulations with animals moving between widely dispersed summer foraging areas in the southern hemisphere and breeding sites in the northern hemisphere (TSSC 2019). In eastern Australia, the species is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Dividing Range and occasionally onto the adjacent inland plains. Further south on the mainland, it is widespread in Victoria, though more so on and south of the Great Dividing Range, and there are few records in western Victoria (TSSC 2019). The concept of an important population is therefore not readily applicable to either the Glossy Black Cockatoo or the White Throated Needletail and important habitat is used in this assessment in place of the important population concept. For the purposes of this assessment, important habitat is considered to include habitat known to be occupied by the species that: • is important either for breeding or dispersal • necessary for maintaining genetic diversity, and/or • near the limit of the species range. Glossy Black Cockatoo are dependent on large hollow-bearing eucalypts for nest sites, specifically living or dead trees with hollows greater than 15 cm diameter and higher than 8 m above the ground (DPIE 2020b). No suitable hollows were located during habitat surveys within the subject land. Therefore, the site is not considered significant for breeding or dispersal, or necessary for maintaining genetic diversity. The species has a broad range from Queensland to Victoria and its area of extent will not be impacted by the proposed rezoning given the subject land is not near the limit of its range. The White-throated Needletail is a migratory species which only breeds within the northern hemisphere and is only found in Australia during the non-breeding period. The subject land is consequently not considered significant for breeding or dispersal, or necessary for maintaining genetic diversity. The species widely disperses for foraging and roosting in the southern hemisphere in areas of Queensland down to eastern Victoria and therefore its area of extent will not be impacted by the proposal given the subject land is not near the limit of its range.

Criteria	Discussion
2. Reduce the area of occupancy of an important population	IUCN guidelines (IUCN 2017) recommend that the area of occupancy of a species is measured by the presence of the species within 2 km x 2 km (400 ha) grid cells. As previously discussed, the subject land does not contain important habitat for Glossy Black Cockatoo such as breeding hollows nor is the subject land located near the limit of the species range. The subject land contains potential foraging habitat for the Glossy Black Cockatoo, as Black She-oak (*Allocasuarina littoralis)*, a major food source for the species, was recorded within PCTs 3586, 3593 and 3807, of which a total of 11.49 ha is proposed to be cleared. Whilst this potential foraging habitat is proposed to be removed by the proposed rezoning, a considerable amount of suitable habitat is also present in the broader locality, including within the broader site proposed to be rezoned for conservation and secured under a BSA. By rezoning this portion of the site to a conservation land use and securing it under a BSA, this will ensure this extent of native vegetation which contains potentially suitable habitat for native species, inclusive of the Glosyy Black Cockatoo, is protected from future development and the biodiversity values will be managed under the requirements of the BSA. Therefore, clearing of 11.49 ha of potential foraging habitat will not significantly reduce the area of occupancy for Glossy Black Cockatoo. Furthermore, it will not reduce the area of occupancy of important habitat, i.e. breeding habitat, critical for the species survival. Similarly for White-throated Needle-tail, the site is not considered to be important habitat for the population as this species only breeds in the northern hemisphere and widely disperses in the southern hemisphere during the non-breeding season. In Australia, the species is mostly aerial, occurring over most types of habitat, most often above wooded areas, including open forest and rainforest, and may also fly below the canopy between trees or in clearings. As the species is mostly aerial and occurs across most types of habitat, the proposed rezoning is considered unlikely to reduce the area of occupancy for the White-throated Needletail.
3. Fragment an important population	Considering the high mobility of both species and the lack of breeding habitat for the Glossy Black Cockatoo, it is unlikely that the proposed rezoning will fragment an important population for the species. Since White-throated Needletail are a migratory species which returns annually to the northern hemisphere to breed, no important habitat such as breeding habitat will be lost as a result of the proposed rezoning. Therefore, an important population of White-throated Needletail is unlikely to be fragmented as a result of proposed rezoning.
4. Adversely affect habitat critical to survival of the species	According to the conservation advice (DCCEEW 2022), habitat critical to the survival of the Glossy Black Cockatoo is broadly defined as areas that are necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development • for the reintroduction of populations or recovery of the species or ecological community. No hollows suitable for breeding for this species were recorded within the study area and no breeding behaviour was recorded during field surveys for Glossy Black Cockatoo. However, potential foraging habitat containing Black She-Oak (*Allocasuarina littoralis)* was recorded within the subject land, of which approximately 11.49 ha would be impacted, which has the potential to adversely impact foraging habitat for the species which is identified as critical habitat for the species (DCCEEW 2022). However, considering the high mobility of the species, and the large areas of similar habitat to the south being retained within the areas proposed for conservation, it is unlikely that the relatively small area of potential foraging habitat within the subject land is critical to the survival of the species. Since White-throated Needletail is a migratory species which returns annually to the northern hemisphere to breed, no important habitat such as breeding habitat will be lost as a result of the proposed rezoning or future development on the site. Therefore, potential impacts would solely be to the potential foraging habitat of White-throated Needletail. However, given White-throated Needle-tail fly over a broad range of habitat types and are found widely spread across the southern hemisphere during the non-breeding season, it is unlikely the relatively small amount of potential foraging habitat within the subject land would be critical to the survival of the species.

Criteria	Discussion
5. Disrupt breeding cycle of an important population	Although Glossy Black Cockatoos were recorded flying over the site during field survey, no evidence of breeding behaviour was observed. Glossy Black Cockatoos typically nest in tree hollows 8 m above the ground with a hollow entrance of greater than or equal to 15 cm and no suitable breeding hollows were recorded within the study area. The White-throated Needle Tail does not breed within Australia (TSSC 2019). The habitat present in the subject land is potentially suitable for roosting and foraging for the species only. However, due to the low density of species records within the locality, the relatively small area of potential habitat proposed to be removed and the fact that the species odes not breed within Australia, it is unlikely the proposed rezoning will disrupt the breeding cycle of the species.
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	Approximately 11.49 ha of potential foraging habitat for the Glossy Black Cockatoo is estimated to be cleared as part of the proposed rezoning. Given the mobility of the species and the large extent of habitat proposed for conservation within the southern portion of the site, the impact is considered unlikely to decrease the availability of habitat to the extent that the species is likely to decline. The White-throated Needletail is predominantly aerial, and is a highly mobile migratory species. Considering the mobility of the species and its ability to forage in fragmented and disturbed areas, it is unlikely that the proposed rezoning will impact the availability of potential habitat to the extent that the species is likely to decline.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	According to the Conservation Advice (DCCEEW 2022), invasive weeds pose a minor threat to the Glossy Black Cockatoo, primarily by altering the floristic and structural characteristics of habitat and by potentially increasing habitat flammability. The conservation advice for the White-throated Needletail (TSSC 2019) does not list any invasive species as a threat but indirect impacts from weed infiltration into suitable foraging and roosting habitat is a possibility. With the implementation of the mitigation measures outlined in Section 6.2, including hygiene practices, such as the cleaning of vehicles and equipment to be used on site, as well as weed control measures through the implementation of a VMP, it is unlikely that any high threat weed species will become established and impact potential foraging habitat for the Glossy Black Cockatoo or the White-throated Needletail.
8. Introduce disease that may cause the species to decline	The Glossy-black Cockatoo is known to be susceptible to the potentially fatal Psittacine Beak and Feather Disease (PBFD) (DCCEEW 2022). PBFD is most likely to spread amongst individuals in breeding habitats with transfer between adults, nestlings and contaminated nest hollows. Breeding habitat for this species has not been identified within the study area and therefore will not create any extra movement for the species to spread disease. The White-throated Needletail is not known to be under threat from any disease (TSSC 2019). Introduction of a disease that may cause either of these species to decline is unlikely. Prior to construction, site hygiene protocols will be prepared which will include minimisation and mitigation measures to prevent the spread of disease throughout the construction and operation of the proposed rezoning.

Criteria	Discussion
9. Interfere with the recovery of the species.	The Conservation Advice for the Glossy Black Cockatoo (DCCEEW 2022) outlines several conservation and recovery actions for the species, of which the following are relevant to the proposed rezoning: • Protect, restore and enhance the quality of known suitable habitat and increase the extent of habitat (both breeding and foraging) for South-eastern Glossy-black Cockatoo across the subspecies' range (both current and future) to maintain viability in response to threats, including climate change. • Protect large old trees and smaller trees that contain large hollows, including those affected by fires. Ensure the recruitment of large old trees by retaining medium-sized trees, facilitating regeneration, and undertaking replanting. No breeding hollows suitable for the species were identified within the study area, however 11.49 ha of potential foraging habitat is estimated to be cleared. While PCTs associated with the Glossy Black Cockatoo within the subject land are in generally high condition, *Allocasuarina littoralis* occurs in low density and is not the dominant vegetation feature within the area to be cleared. Considering this, and the overall mobility of the species, the proposed rezoning is not considered to interfere with the recovery of the species. No Recovery Plan or Listing Advice has been created for the White-throated Needletail. The conservation advice (TSSC 2019) for the species lists conservation actions. The following is a subset of these actions, relevant to the proposed rezoning: • support initiatives to improve habitat management at key sites in Australia • ensure important habitats in Australia are identified and protected. Due to the low density of records in the locality, the proposed rezoning is unlikely to affect key or important habitat or otherwise interfere substantially with the recovery of the species.
Conclusion	A significant impact to Glossy Black Cockatoo and White-throated Needletail is unlikely to occur as a result of the proposed rezoning as: • No breeding habitat occurs within the study area for Glossy Black Cockatoo or White-throated Needletail, and therefore the vegetation to be cleared is not considered important for the breeding or dispersal of either species, and subsequent maintenance of genetic diversity. The potential habitat is not considered important in terms of distribution, as the site is not located at the limit of either species range. • The area of occupancy of an important population will not be impacted as no important habitat as defined in Criteria 1 will be removed. Potential foraging habitat constituting 11.49 ha for Glossy Black Cockatoo, and 13.39 ha for White-throated Needletail is proposed to be removed, but this is considered minimal given the large expanse of habitat proposed for conservation in the southern portion of the site, as well as within the broader landscape. • Weed species pose a threat to Glossy Black Cockatoo and White-throated Needletail habitat due to factors such as changes in floristic structure and composition, which can also contribute to altered fire regimes. However, provided the proposed mitigation measures are implemented (refer to Section 6), it is unlikely the proposed rezoning will result in invasive species becoming established. • The Psittacine Beak and Feather disease, which affects Glossy Black Cockatoo is unlikely to be introduced and spread on site as it is associated with breeding habitat and behaviour, and no breeding habitat was identified within the study area. Additional hygiene practices will nonetheless be put in place to help mitigate introduction of this disease. No diseases are known to be a threat to White-throated Needletail. • Although potential foraging habitat occurs within the subject land, in the form of Black Sheoak (*Allocasuarina littoralis*), a preferred feed species for Glossy Black Cockatoo, this species was recorded in low densities. The large portion of the site proposed for conservation should continue to provide similar foraging habitat to the vegetation being removed, such that there is no risk to the species recovery. • No Recover Plan or Listing Advice has been created for White-throated Needletail. However, the proposed rezoning is unlikely to interfere with the recovery of this species given the site is not considered a key site or important habitat within Australia for White-throated Needletail.

E.1.2 Flora

Table E.2 Heath Wrinklewort

Criteria	Discussion
1. Long-term decrease of an important population	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity • populations that are near the limit of the species' range. The species mostly inhabits heath and is often found along disturbed roadsides. It occurs on moist sites in open forest and in sedgeland/heathland within shrubby open forest and woodland (DCCEEW 2008a). The subject land provides potentially suitable habitat characteristic of the species within PCT 3807 – Northern Sydney Heath-Mallee and PCT 3924 – Sydney Coastal Upland Swamp Heath, comprising a total of 2.27 ha. However, according to the TBDC (DCCEEW 2008a), this species is found north of Wyong on the Central Coast, with the closest record being located approximately 20 km north-east of the subject land, just south of Warnervale. About 2 km north of these scattered records is a large population centred around the Wallarah area. The site is outside the current known distribution of this species, with no records within 20 km. It is therefore considered unlikely that the area within the subject land contains an important population, which could be impacted. Furthermore, only a small area of potential habitat, 2.26 ha, will be impacted with large areas of suitable habitat being retained in the area proposed for conservation.
2. Reduce the area of occupancy of an important population	As outlined above, the subject land is unlikely to contain an important population of Heath Wrinklewort. The proposed rezoning is therefore unlikely to reduce the area of occupancy to an important population of the species.
3. Fragment an important population	The subject land is unlikely to contain an important population of Heath Wrinklewort. The proposed rezoning is therefore unlikely to fragment an important population of the species.
4. Adversely affect habitat critical to survival of the species	Habitat critical to the survival of the species is not defined in the conservation advice for the species (DCCEEW 2008a). Habitat critical to the survival may include areas that are necessary for: • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development • the reintroduction of populations or recovery of the species or ecological community There are no known records of the species within the subject land, with the closest potential source population being approximately 20 km to the north-east. This population has scattered records just south of Warnervale which is the southernmost record within the species range. Dispersal between the closest records and the subject land is considered highly unlikely given the distance between the two. Additionally, the clearing of 2.26 ha of potential habitat is unlikely to adversely affect habitat critical to the survival of the species, especially when large areas of suitable habitat will be retained in the area proposed for conservation.
5. Disrupt breeding cycle of an important population	The subject land is unlikely to contain an important population of Heath Wrinklewort. The proposed rezoning is therefore unlikely to disrupt the breeding cycle of an important population of the species.
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	As no known populations occur south of Wyong, it is unlikely the potential habitat in the subject land is critical to the survival of the species such that the removal of 2.27 ha would cause the species to decline. Large areas of potential habitat will still be retained in the area proposed for conservation beyond the biocertification boundary.

Criteria	Discussion
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and establishment of weed species as a result of the proposed rezoning is a risk to potential habitat being retained for the Heath Wrinklewort within the conserved lands. A number of strategies are proposed to be implemented to prevent invasive species impacting protected areas as per Section 6. These include appropriate weed prevention measures such as the cleaning of equipment and vehicles on site to minimise weed seed introduction. Stormwater management systems are to be put in place for the development to prevent run off and subsequent weed dispersal into retained bushland areas. A VMP has also been recommended to manage the area proposed for conservation and control any weeds introduced on the subject land and surrounding areas. Provided the recommended weed control measures outlined in Section 6.2 are implemented, it is unlikely that the proposed rezoning will introduce invasive species harmful to the Heath Wrinklewort.
8. Introduce disease that may cause the species to decline	No diseases are listed which are a threat to Heath Wrinklewort (DCCEEW 2008a). Hygiene practices such as the washing of vehicles and equipment are proposed to be implemented to minimise the introduction of pest and disease on the subject land and surrounding areas.
9. Interfere with the recovery of the species	There is no approved national recovery plan for the species, however the species is mentioned in several regional management strategies and summarised in the conservation advice (DCCEEW 2008a) which outline general recovery actions, of which only the prevention of habitat loss and fragmentation are relevant to the proposed rezoning. The proposed rezoning will clear approximately 2.27 ha of potentially suitable habitat for Heath Wrinklewort. However, given that the subject land is located approximately 20 km south-east of the southernmost high-density population in the species range it is unlikely that the proposed rezoning will lead to habitat loss or fragmentation to the degree that it would interfere with the recovery of the species.
Conclusion	A significant impact to the Heath Wrinkewort is unlikely to occur as a result of the proposed rezoning as: • The clearing of 2.27 ha of potential habitat is not considered likely to contribute to the long-term decrease in an important Heath Wrinklewort population. The site is located 20 km south-west of the nearest record and is outside the known distribution for the species. No populations are known to occur in this area. Regardless, the clearing of 2.27 ha will be minimal compared to the large area of suitable habitat being preserved in the area proposed for conservation. • No important populations were detected within the subject land and therefore the area of occupancy will not be reduced nor area of habitat fragmented. • As no known populations occur south of Wyong, it is unlikely the habitat on the subject land is critical to the survival of the species. Large areas of potential habitat will also be retained within the area proposed for conservation. • The lifecycle of an important population of the species will not be disrupted as no individuals were recorded during flora survey effort. It is noted that while flora survey effort was conducted throughout the site, Heath Wrinklewort was not a targeted species, and occurrence cannot be completed ruled out. • The removal of potential habitat is not likely to contribute to the availability of habitat for the species such that it would contribute to the species decline. The subject land is outside the known distribution for the species and therefore removal of this habitat is unlikely to contribute to the decline of this species. • Mitigation measures are proposed to prevent harmful invasive weed species and disease which may threaten potential habitat of Heath Wrinklewort. • The clearing of 2.27 ha of potential habitat outside of the species known distribution is unlikely to significantly interfere with the recovery of the species. Large areas of suitable potential habitat will be retained within the areas proposed for conservation, providing potential future habitat for the species.

Table E.3 Biconvex Paperbark

Criteria	Discussion
1. Long-term decrease of an important population	An 'important population' is not defined by the conservation advice for the species (DCEEW 2008b). For the purposes of this assessment and important population is considered to be: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range The species occurs in damp places, often near streams and rivers or low-lying areas on alluvial soils of low slopes or sheltered aspects. It occurs in coastal districts and adjacent tablelands. Biconvex Paperbark may occur in dense stands forming a narrow strip adjacent to watercourses. As such, only PCT 3924, the Upland Swamp Heath community, was classed as potential habitat for this species, as all other PCTs are associated with sandstone slopes, crests or ridges. This amounts to 1.83 ha of potential habitat within the subject land. While there are no records within the subject land, there are sparse records of occurrence along Fountain Creek and associated streams which run approximately 100 m south of the subject land. It is considered that the records in proximity to the subject land are not part of a key source population as they are generally sporadic and likely spread from the higher density and more coastal areas of the species distribution. Although EMM did not undertake targeted surveys for this species, surveys have been completed every year since 2018 for two other *Melaleuca sp.*, *Melaleuca deanei* and *Melaleuca groveana* within the study area. No individuals of Biconvex Paperbark were identified during field surveys and there are no historical records of the species within the subject land. Potential suitable habitat of Swamp Upland Heath to be cleared, is 1.83 ha, and this habitat appears less likely to support the species versus the riparian areas along Fountain Creek where existing records are. It is unlikely the proposed rezoning will cause the long-term decrease of an important population of Biconvex Paperbark, especially considering known existing individuals within the area proposed for conservation area will be protected.
2. Reduce the area of occupancy of an important population	The subject land is unlikely to contain an important population of Biconvex Paperbark. The proposed rezoning is therefore unlikely to reduce the area of occupancy of an important population of the species.
3. Fragment an important population	The subject land is unlikely to contain an important population of Biconvex Paperbark. The proposed rezoning is therefore unlikely to fragment an important population of the species.
4. Adversely affect habitat critical to survival of the species	Habitat critical to the survival of the species is not defined in the conservation advice for the species (DCEEW 2008b). Habitat critical to the survival of a species may include areas that are necessary for: • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community As previously mentioned, no individuals of Biconvex Paperbark have been recorded within the subject land during the field surveys for *Melaleuca deanei* and *Melaleuca groveana* and there are no historical records of the species. Scattered historical records exist 100 m south of the footprint, along Fountain Creek, and likely associated with the Upland Swamp Heath community, of which 0.83 ha will be impacted. Since the only recordings of this species within the wider site area are within the creek lines, which are to be avoided, it is unlikely the proposed rezoning will adversely affect habitat critical to the survival of the species.
5. Disrupt breeding cycle of an important population	As outlined above, the subject land is unlikely to contain an important population of Biconvex Paperbark. The proposed rezoning is therefore unlikely to disrupt the breeding cycle of an important population of the species.

Criteria	Discussion
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	Approximately 1.83 ha of suitable habitat will be cleared within the subject land, which is located approximately 100 m to the north of the Fountain Creek watercourse where the species has been recorded in the locality. There is the possibility of indirect impacts to the habitat of existing individuals and potential Biconvex Paperbark habitat due to altered hydrology within the broader site. Development may result in increased runoff and nutrient loading, or conversely, water being slowed or diverted away from riparian and swamp areas, which rely on flooding regimes for their survival. Stormwater management systems are to be put in place to minimise changes in current water quality and runoff (refer to Section 6.2). Therefore, due to these mitigation measures, it is unlikely that the clearing of 1.83 ha will result in indirect impacts to the potential or existing species habitat within the area proposed for conservation such that the species is likely to decline.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is potential for weed species and pathogens to be inadvertently brought into the subject land with imported materials, equipment, or the establishment of gardens, resulting in the degradation of retained native vegetation and habitat. Given the management measures proposed such as prevention of runoff from development areas into surrounding vegetation and removal of high threat weeds with the implementation of a VMP, it is unlikely that any invasive species that are harmful to the Biconvex Paperbark will become established in the subject land nor surrounding areas as a result of the proposed rezoning.
8. Introduce disease that may cause the species to decline	Being part of the Myrtaceae family, Biconvex Paperbark is potentially affected by Myrtle Rust, a disease caused by the exotic fungus *Austropuccinia psidii* which can cause loss of fertility, stunt growth and ultimately kill plants (DCEEW 2008b). There is potential for weed species and pathogens to be inadvertently brought into the subject land with imported materials, equipment, or the establishment of gardens, and can result in the degradation of retained native vegetation and habitat. Given the management measures proposed such as prevention of run off from development areas into surrounding vegetation and ensuring any material and equipment brought into the subject land is clean and free of seeds, it is unlikely that any diseases that are harmful to the species will become established in the subject land nor surrounding areas as a result of the proposed rezoning.
9. Interfere with the recovery of the species	There is no approved national recovery plan for the species however the conservation advice (DCEEW 2008b) does outline prevention of habitat loss and alteration to water tables as being the primary recovery goals for the species which are relevant to the proposed rezoning. The proposed rezoning will clear approximately 1.83 ha of potentially suitable habitat for the species, however, large areas of suitable habitat will be retained within the areas proposed for conservation. Known habitat along watercourses is to be avoided and will be protected within areas proposed for conservation. The proposed rezoning will implement stormwater systems to prevent impacts such as increased runoff and nutrient loading to local creeks and swampland and potential alteration to the water table in the area. Weed control measures including hygiene practices, stormwater management and a VMP will limit the likelihood of existing and potential habitat becoming degraded through weed encroachment. Therefore, it is unlikely the proposed rezoning will interfere with the recovery of the species.

Criteria	Discussion
Conclusion	The proposed rezoning is unlikely to significantly impact Biconvex Paperbark as: • No individuals were located within the subject land during *Melaleuca sp.* surveys, making it unlikely an important population exists within the proposed clearing areas. All historical records are located south of the subject land along Fountain Creek and are scattered. • The subject land is unlikely to support an important population and therefore no reduction in area or fragmentation of habitat for of an important population of Biconvex Paperbark is likely to occur. Likewise, the breeding cycle of an important population is unlikely to be disrupted. • Only 1.83 ha of potential suitable habitat is proposed for clearing, whilst large areas the same habitat (Upland Swamp Heath) will be retained within the area proposed for conservation. All riparian areas including areas with existing records are at least 100 m from the subject land and are to be retained. • Indirect impacts from stormwater runoff from the proposed rezoning are to be managed so that existing and potential Biconvex Paperbark riparian and swamp habitat within the areas proposed for conservation is unlikely to be adversely affected. • Hygiene practices are to be put in place to limit weed seed being brought to site and dispersed and to prevent the introduction of Myrtle Rust. This includes the cleaning of vehicles and equipment. • Mitigation measures are to be designed to protect potential and existing habitat on the subject land and broader site from direct and indirect impacts so that the recovery of the species is not jeopardised.

E.1.3 Mammals

Table E.4 Yellow-Bellied Glider

Criteria	Discussion
1. Long-term decrease of an important population	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The subject land is not within nor adjacent to any important population listed in the conservation advice (DAWE 2022b) for the species. There are no records of Yellow-bellied Glider within the subject land, though there are a low number of records within proximity to the subject land (ALA n.d.). The majority of records, however, are located in Ourimbah State Forest and Jilliby State Conservation Area to the north with intermittent records towards the east coast. Although EMM did not undertake targeted surveys for this species, surveys for similar arboreal mammals including the Greater Glider were completed and no individuals of Yellow-bellied Glider were incidentally recorded. It was concluded based on these findings and the low number of records, that the species is unlikely to be denning or breeding within the subject land, though the broader site may be used intermittently for foraging. It is considered that the records in proximity to the subject land are not part of a key source population as they are generally sporadic and likely spread from the higher density and more coastal areas of the species distribution. The locality in which the site is situated is not known or likely to be a stronghold for the species which is concentrated in more continuous areas of vegetation within Ourimbah State Forest and Jilliby State Conservation area to the north. The habitat within the subject land is not likely to support a key source population or a population necessary for maintaining genetic diversity. The subject land is in an area where the species has been infrequently recorded and is not near the limit of the species range. Therefore, any potential occurrence of the species is unlikely to be an important population.

Criteria	Discussion
2. Reduce the area of occupancy of an important population.	The subject land is unlikely to contain an important population of the Yellow-bellied Glider and therefore the removal of vegetation within the subject land is unlikely to reduce the area of occupancy of an important population of the species.
3. Fragment an important population	The subject land is unlikely to contain an important population of the Yellow-bellied Glider and therefore the removal of vegetation within the subject land is unlikely to fragment an existing important population of the species into two or more populations.
4. Adversely affect habitat critical to survival of the species	No critical habitat has been listed for the species under the EPBC Act. Habitat critical to the survival of the species may also include areas not listed on the Register of Critical Habitat, if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development. Habitat critical to the survival of the Yellow-bellied Glider according to the Conservation Advice (DAWE 2022b) for the species includes: • large contiguous areas of floristically diverse eucalypt forest, which are dominated by winter-flowering and smooth-barked eucalypts, including mature living hollow-bearing trees and sap trees • areas identified as refuges under future climate change scenarios • short or long-term post-fire refuges (i.e. unburnt habitat within or adjacent to recently burnt landscapes) that allow the species to persist, recover and recolonise burnt areas • habitat corridors required to facilitate dispersal of the subspecies between fragmented habitat patches and/or that enable recolonization or movement away from threats. • areas in which some trees have evidence of use for sap extraction by Yellow-bellied Glider (south-eastern) (reference conservation advice). It is possible that habitat is intermittently used to forage considering the large home ranges of the species. The proposal would lead to a decrease in the potential habitat available for the species by 11.49 ha across PCTs 3586, 3593 and 3807. PCT 3924 was excluded based on the lack of canopy within this community. However, no known records exist of Yellow-bellied Glider within the subject land, with the closest records occurring in Strickland State Forest and Jilliby State Conservation Area to the north. This is despite the broader site having reasonable connectivity with Strickland State Forest. Furthermore, surveys by EMM did not detect this species during arboreal mammal surveys for Greater Glider. This is possibly because the study area is not dominated by the preferred foraging habitat of the species, winter-flowering eucalypts, though sap trees such as *Corymbia gummifera* were recorded. Given the lack of historical records, and no evidence of the species in the study area during field surveys, it is considered unlikely the potential habitat within the subject land is critical to the survival of the species. The large number of records within Strickland State Forest suggests this habitat is being used preferentially to vegetation within the subject land, despite connectivity, potentially due to the foraging habitat on the subject land and broader site lacking winter-flowering eucalypts, an important food source for the species.
5. Disrupt breeding cycle of an important population	The subject land is unlikely to contain an important population of the Yellow-bellied Glider. The proposed rezoning is therefore unlikely to disrupt the breeding cycle of an important population of the species.

Criteria	Discussion
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The Yellow-bellied Glider may use the subject land and broader site intermittently for foraging but is unlikely to utilise the subject land as a stronghold for denning or breeding. This is firstly because it was not detected during arboreal surveys conducted by EMM for similar species including the Greater Glider and due to a lack of records proximal to the subject land. Areas containing a high density of records occur to the north within Ourimbah State Forest and Jilliby State Conservation Area and intermittently to the east. These areas are where the species is likely to persist and extend its home range (50-65 ha) (DAWE 2022b). The proposal would result in a reduction in the availability of potential habitat by up to 11.49 ha. However, it is unlikely to cause the species to decline, due to the small proportion of any local population in the locality that may be impacted, and the lack of any evidence that the habitat on the subject land is occupied by the species.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	The existing landscape contains invasive species that are directly or indirectly harmful to the species through predation including from feral cats and European fox, habitat degradation from species such as feral deer or alteration of habitat through the introduction of high threat weed species. Development of the subject land may result in an increase in invasive species harmful to the species habitat. Mitigation measures are likely best addressed through a VMP, which can detail measures of deterring pests such as through fencing, or more direct pest control measures aimed at controlling numbers. The VMP would also detail a plan for weed management. Given the management measures proposed (refer to Section 6), it is unlikely that any further species invasions will be facilitated by the proposed rezoning. Therefore, the proposed rezoning is considered unlikely to facilitate the spread of invasive species harmful to the survival of the species (either directly or indirectly).
8. Introduce disease that may cause the species to decline.	The Conservation Advice for the species (DAWE 2022b) does not list any disease that is a key threat to the species. It is also unlikely that any disease that may cause the species to decline will be introduced by the proposed rezoning.
9. Interfere with the recovery of the species.	A recovery plan has not yet been prepared for the species. Conservation and management priorities are identified in the conservation advice for the species and include measures to address: • habitat loss, disturbance and modifications (including fire) • climate change • invasive species (including threats from grazing, trampling, predation). The proposed rezoning may detract from the recovery of the species due to the removal of some potential habitat. As the subject land is unlikely to support an important population or to contain habitat critical to the survival of a species, the loss of potential habitat as a result of the proposed rezoning is unlikely to interfere substantially with the recovery of the species. The proposed rezoning is also unlikely to exacerbate climate-related nor invasive species impacts to the Yellow-bellied Glider. The proposed rezoning is therefore unlikely to interfere substantially with the recovery of the species.

Criteria	Discussion
Conclusion	The proposed rezoning is unlikely to significantly impact the Yellow-bellied Glider as: • There are no records of Yellow-bellied Glider within the subject land and a low number of proximal records to the subject land. No Yellow-bellied Gliders were detected during surveys by EMM targeting a similar arboreal mammal, the Greater Glider. Therefore, it is unlikely the species is using the subject land for breeding or denning and that an important population will be impacted by the proposed rezoning. • It is unlikely the area of occupancy of the species will be reduced or fragmented given the lack of evidence of the species breeding or denning within the subject land. Similarly, it is unlikely the breeding cycle of an important population would be disrupted as a result of the proposed rezoning. • There are no records of Yellow-bellied Glider within the subject land and no Yellow-bellied Gliders were detected during surveys by EMM targeting Greater Glider. Therefore, it is unlikely that the potential habitat within the subject land is critical for the survival of the species. Large areas of bushland adjacent the subject land will be retained, which will continue to provide habitat for any local populations of Yellow-bellied Glider. • A lack of historical records and no detection of the species during field surveys, suggests the species would only be using the subject land for intermittent foraging. Higher numbers of historical records within Strickland State Forest to the north indicates more suitable and preferred foraging habitat may occur within the broader locality. As such it is unlikely the subject land contains habitat critical to the survival of the species. • Mitigation measures such as the implementation of a VMP will ensure pest species and invasive weeds which are a threat to the species and its habitat are kept under control. • No diseases are associated with Yellow-bellied Glider as per the Conservation Advice for the species (DAWE 2022b). General hygiene practices during clearing and construction will be implemented regardless. • Lack of records and no detection of the species through field surveys suggests any locally occurring Yellow-bellied Glider populations are small. Therefore, it is unlikely the proposed rezoning will interfere with the recovery of the species, especially given the large areas of habitat to be retained within the areas proposed for conservation.

Table E.5 Grey-headed Flying-fox

Criteria	Discussion
1. Long-term decrease of an important population	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The Grey-headed Flying-fox exists as a series of interconnected subpopulations with animals moving between widely dispersed roosting and breeding sites (DCCEEW 2021b). The concept of an important population is not readily applicable to this species. For the purposes of this assessment important habitat has been used to assess whether an impact on an 'important population' is likely. Important habitat for the Grey-headed Flying-fox is likely to include camp sites used for roosting and breeding and extensive areas of forest and woodland, particularly those that contain tree species that flower or fruit in winter and spring when food resources for the species are generally scarce (DCEEW 2021). Important winter and spring vegetation communities are those that contain *Eucalyptus tereticornis, E. albens, E. crebra, E. fibrosa, E. melliodora, E. paniculata, E. pilularis, E. robusta, E. seeana, E. sideroxylon, E. siderophloia, Banksia integrifolia, Castanospermum australe, Corymbia citriodora citriodora, C. eximia, C. maculata, Grevillea robusta, Melaleuca quinquenervia* or *Syncarpia glomulifera* (DCEEW 2021). The site is not dominated by any of these species. The closest known flying-fox camp is approximately 7 km to the East at Mount Elliot. This population has recorded between greater than 10,000 individuals as recently as 2019, making it a nationally important camp (DCCEEW 2021a). Grey-headed Flying-fox can travel as far as 40 km to forage and return to their camp at night (DCCEEW 2021b). For this reason, it is likely that any occurrence of the Grey-headed Flying-fox within the subject land is to be part of an important population. There will be a reduction in potential foraging habitat by up to 13.32 ha (the area of native vegetation within the subject land). However, due to the lack of known utilisation of the subject land as no individuals were observed during any surveys in the study area, it is unlikely the proposed rezoning may result in a decrease in the availability of foraging habitat for an important population.
2. Reduce the area of occupancy of an important population	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 km x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act. The proposed rezoning is unlikely to reduce the area of occupancy as defined by a 2 km x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.
3. Fragment an important population	Due to the mobility of this species, and its ability to traverse large areas of highly modified landscapes, the proposed rezoning is unlikely to fragment an existing important population into two or more populations.

Criteria	Discussion
4. Adversely affect habitat critical to survival of the species	No critical habitat has been listed for the species under the EPBC Act. Habitat critical to the survival of the species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development. Winter and spring foraging resources are habitat critical to the survival of the species in the species recovery plan (DCCEEW 2021b). Important winter and spring vegetation communities are those that contain *Eucalyptus tereticornis, E. albens, E. crebra, E. fibrosa, E. melliodora, E. paniculata, E. pilularis, E. robusta, E. seeana, E. sideroxylon, E. siderophloia, Banksia integrifolia, Castanospermum australe, Corymbia citriodora citriodora, C. eximia, C. maculata, Grevillea robusta, Melaleuca quinquenervia* or *Syncarpia glomulifera* (DAWE 2021). The site is not dominated by any of these species. The loss of roosting habitat has also been identified as a threat to Grey-headed Flying-foxes (DCCEEW 2021b). No roosting habitat has been identified within the subject land, with the closest camp being approximately 7 km to the east. There will be a reduction in potential foraging habitat by up to 13.32 ha. However, due to the lack of known utilisation of the site, the small scale of clearing proposed within the subject land in comparison to the surrounding vegetation to be retained, as well as the distance of the subject land from known camp and roosting sites, it is unlikely the proposed rezoning will affect habitat critical to the survival of the species.
5. Disrupt breeding cycle of an important population	No camp sites (roosting and breeding habitat) for the Grey-headed Flying-fox were identified within or near to the subject land. The nearest known camp sites are at Mount Elliott, approximately 7 km to the east and Woy Woy approximately 9 km to the south-east. Due to the distance of the subject land from known roosting and breeding sites, it is unlikely to disrupt the breeding cycle of an important population of the species.
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The proposed rezoning would reduce available foraging habitat by up to 13.32 ha, however this habitat is unlikely to be frequently utilised by the species due to the lack of important vegetation communities and canopy species favoured for foraging. This is evidenced by the number of records proximal to the site (>100), yet no records exist of Grey-headed Flying-fox visiting the subject land, including during the extensive survey effort conducted within the study area. This suggests other areas within the locality are being preferentially used for foraging over the subject land. Therefore, due to the lack of important vegetation for foraging on site and the lack of records within the subject land and broader site, it is unlikely the proposed rezoning would reduce the availability of habitat which would cause the species to decline.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The existing landscape contains invasive species that are directly or indirectly harmful to the species through predation, competition or alteration of habitat. With the appropriate implementation of the mitigation measures proposed in Section 6, it is unlikely that any further species invasions will be facilitated by the proposed rezoning. Therefore, the proposed impacts are considered unlikely to facilitate the spread of invasive species or their adverse impacts to the survival of the Grey-headed Flying-fox (either directly or indirectly).
8. Introduce disease that may cause the species to decline	The Grey-Headed Flying Fox may be susceptible to diseases such as White Nose Syndrome, which has not been identified in Australia and *Angiostrongylosis* which is at a point of requiring further research to quantify potential impact to the species at a population level (DCCEEW 2021b). However, given the management measures proposed in Section 6, including hygiene practices such as the washing down of vehicles and equipment to be used, it is unlikely that any disease that may cause the species to decline will be introduced as a result of the proposed rezoning.

Criteria	Discussion
9. Interfere with the recovery of the species	The National Recovery Plan for the Grey-headed Flying-fox outlines recovery objectives (DCCEEW 2021b). The following is a subset of these objectives, targeting actions relevant to the proposed rezoning: • Identify, protect and increase native foraging habitat that is critical to the survival of the Grey-headed Flying-fox. • Identify, protect and increase roosting habitat of Grey-headed Flying-fox camps. The proposed rezoning may detract from the recovery of the species due to the removal of potential foraging habitat but is unlikely to affect important or critical habitat. Due to the small proportion of available habitat likely to be impacted, and the lack of any evidence that the affected habitat is frequently utilised, the proposed rezoning is unlikely to substantially interfere with the recovery of the Grey headed Flying-fox.
Conclusion	The proposed rezoning is unlikely to significantly impact the Grey-headed Flying-fox as: • Important habitat for Grey-headed Flying-fox includes camps used for breeding and roosting of which none have been recorded on the subject land. If the subject land is being utilised by the species it would only be for foraging. • As no important habitat occurs on the subject land, no important populations are at risk of being fragmented or having their area of occupancy reduced as a result of the proposed rezoning. Similarly, no important populations will have their breeding cycles disrupted as no breeding camps have been identified on the subject land. • No critical habitat is likely to be removed due to the proposed rezoning. Important vegetation communities and significant canopy species critical for Grey-headed Flying-fox foraging were not recorded within the subject land. Large areas of habitat will be conserved within the broader site for intermittent foraging for the species. • There are a number of records within proximity to the subject land, particularly to the east, but no records within the subject land, suggesting the species is using other habitats within the locality likely containing more preferable foraging habitat. Therefore, the removal of habitat within the subject land is unlikely to contribute to the decline of the species. • Hygiene practices are to be put in place to prevent diseases affecting Grey-headed Flying-fox from being introduced on the subject land and potentially impacting the species. • No breeding habitat occurs on the subject land, nor is the vegetation in the subject land considered to be important for Grey-headed Flying-fox foraging. Subsequently the proposed rezoning is unlikely to interfere with the recovery of the species.

Table E.6 New Holland Mouse (*Pseudomys novaehollandiae*)

Criteria	Discussion
1. Long-term decrease of an important population	The listing advice (TSSC 2010) and the Conservation Advice (DCCEEW 2024a) for the New Holland Mouse (*Pseudomys novaehollandiae*) do not define an important population. Therefore, in accordance with the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DEWHA 2013), important populations for the purposes of this assessment are considered to be: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. Atlas of Living Australia (ALA n.d.) identifies one historical record of the New Holland Mouse from 1973 located outside of the study area, but within the broader site. The New Holland Mouse is known to inhabit a range of habitats including open heathland, open woodland with a heathland or grassy understory, tall open forest with a grassy understorey and vegetated sand dunes (DCCEEW 2023a, DCCEEW 2024b). Soil type may be an important indicator of suitability of habitat for the species with deeper top soils and softer substrates being preferred for digging burrows. Other factors such as slope, geology and the amount of sun received in an area may also influence site selection (DCCEEW 2023a). The study area contains potentially suitable vegetation types with areas of deeper sandy soils as described for the species, in particular within the areas mapped as PCT 3593 (refer to Table 4.5). Whilst potential suitable habitat is located within the subject land, a considerable amount of suitable habitat is also present in the broader locality. Review of the SVTM (NSW DCCEEW 2024) indicates that PCT 3593 is the dominant PCT mapped surrounding the study area, including within the broader site. As part of the proposed rezoning, the area of the site that is not conferred for biocertification is proposed to be rezoned from Rural Residential (RU2) to Environmental Conservation (C2). Furthermore, Darkinjung propose to secure the portion of the site to be rezoned to Environmental Conservation under a BSA. By rezoning this portion of the site to a conservation land use and securing it under a BSA, this will ensure this extent of native vegetation which contains potentially suitable habitat for native species, inclusive of the New Holland Mouse, is protected from future development and the biodiversity values will be managed under the requirements of the BSA. The vegetation within the subject land that would be most suitable for the New Holland Mouse is located along the interface with Reeves Street and is therefore more susceptible to edge effects than areas positioned away from roads and tracks. Furthermore, only historic records of the species occur within the vicinity of the subject land. Given the availability of large tracts of similar vegetation that is continuous with the subject land, including areas proposed for conservation, it is unlikely that an important population is solely reliant on the potential habitat within the study area, and it is considered unlikely that the proposed rezoning will lead to a long-term decrease in the size of an important population.
2. Reduce the area of occupancy of an important population	IUCN guidelines recommend that the area of occupancy of a species is measured by the presence of the species within 2 km x 2 km (400 ha) grid cells. Only historic records of the species occur within the vicinity of the study area. In accordance with the IUCN guidelines, the proposed rezoning is unlikely to reduce the area of occupancy of the species based on available records. As the New Holland Mouse is an ecosystem credit species under the BAM (DPIE 2020a), targeted surveys were not required to be conducted for the species within the study area. As discussed above, whilst there is potentially suitable habitat within the subject land, a considerable amount of suitable habitat is also present in the broader locality. Furthermore, as the area of land not conferred for biocertification is proposed to be rezoned to Environment Conservation, including the area in which the historical record is located, this will ensure the ongoing management of this extent of potentially suitable habitat. Given this, it is considered unlikely that an important population is solely reliant on the potential habitat within the study area, and it is unlikely that the proposed rezoning will reduce the area of occupancy of an important population.

Criteria	Discussion
3. Fragment an important population	Whilst there is potentially suitable habitat within the subject land, a considerable amount of suitable habitat is also present in the broader locality, and it is considered unlikely that an important population is solely reliant on the potential habitat within the subject land. Furthermore, as the area of land not conferred for biocertification is proposed to be rezoned to Environment Conservation, including the area in which the historical record is located, this will ensure the ongoing management of this extent of potentially suitable habitat. Avoidance and minimisation measures proposed for the project, as outlined in Section 6, have taken into consideration the connectivity of habitat within and surrounding the subject land. The subject land has been designed to leave a corridor of intact vegetation between the two areas proposed for future development, which will help to maintain connectivity between areas to the north and south of the subject land (Figure 6.1), Given the above, it is considered unlikely that an important population is solely reliant on the potential habitat within the subject land and it is unlikely that the proposed rezoning will fragment an important population.
4. Adversely affect habitat critical to survival of the species	Habitat critical to the survival of a species is defined in the species Conservation Advice (DCCEEW 2024a) as being areas that are necessary: • for activities such as foraging, breeding, shelter, or dispersal • for the long-term maintenance of the species (including the maintenance of species/subspecies essential to the survival of the species) • to maintain genetic diversity and long-term evolutionary development • for the reintroduction of populations or recovery of the species. As discussed above, whilst there is potentially suitable habitat within the subject land, a considerable amount of suitable habitat is also present in the broader locality. The vegetation within the subject land that would be most suitable for the New Holland Mouse is located along the interface with Reeves Street and is therefore more susceptible to edge effects than areas positioned away from roads and tracks. Furthermore, as the area of land within the site not conferred for biocertification is proposed to be rezoned to Environment Conservation and secured under a BSA, including the area in which the historical record is located, this will ensure the ongoing management of this extent of potentially suitable habitat. Given this, it is unlikely that habitat critical to the survival of the New Holland Mouse will be adversely affected by the proposed rezoning.
5. Disrupt breeding cycle of an important population	DCCEEW (2024a) indicates threats to regular breeding of this species include the introduction of *Phytophthora cinnamomi* causing disruption to the breeding cycle due to habitat modification, as well as small and fragmented populations being susceptible to low genetic diversity and inbreeding. With appropriate implementation of the mitigation measures proposed in Section 6, which include preventing the introduction of harmful pathogens, it is unlikely that the proposed rezoning would introduce or exacerbate the spread of *Phytophthora cinnamomi* and disrupt the breeding cycle of the New Holland Mouse. Furthermore, the subject land has been placed to ensure that the regional biodiversity corridor that lies to the east of the subject land remains most unaffected, and has been designed to leave a corridor of intact vegetation between the two areas proposed for future development, which will help to maintain connectivity between areas to the north and south of the subject land (Section 6, Figure 6.1). With the implementation of these avoidance and minimisation measures, the proposed rezoning is unlikely to fragment populations of mobile fauna species. A considerable amount of suitable habitat is also present in the broader locality surrounding the subject land, and it is considered unlikely that an important population would be solely reliant on the potential habitat within the subject land. Given the above, it is considered unlikely that the proposed rezoning will disrupt the breeding cycle of an important population of the New Holland Mouse.

Criteria	Discussion
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	A considerable amount of suitable habitat will remain within the broader locality of the subject land, including within the broader site. As the area of land within the site not conferred for biocertification is proposed to be rezoned to Environment Conservation and secured under a BSA, including the area in which the historical record is located, this will ensure that this extent of potentially suitable habitat is retained and managed under the BSA requirements. The subject land has been designed to leave a corridor of intact vegetation between the two areas proposed for future development, which will help to maintain connectivity between areas to the north and south of the subject land (Figure 6.1) and prevent isolation of areas of habitat. Given this, it is unlikely that the proposed rezoning will modify, destroy, remove, isolate or decrease the availability of habitat to the extent that the New Holland Mouse is likely to decline.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The New Holland Mouse is susceptible to predation by both foxes and feral cats (DCCEEW 2024a). Avoidance and minimisation measures proposed for the project, as outlined in Section 6, will include controls on domestic pet species and species of garden plantings that will be enforced under 88B and 88E covenants. Additional measures aimed at prevention of the spread of weeds and pathogens are also proposed, which are outlined in Section 6. With the implementation of these measures, it is unlikely that the proposed rezoning will introduce invasive species harmful to the New Holland Mouse.
8. Introduce disease that may cause the species to decline	The New Holland mouse is potentially directly affected by *Taxoplasma gondii,* a virulent pathogen that can cause the disease toxoplasmosis. This pathogen is spread by cats and is found throughout the range of the New Holland mouse (DCCEEW 2024a). Additionally, the species may also be indirectly affected by *Phytophthora cinnamomi* which may reduce overall food availability for the species through degradation of vegetation health (DCCEEW 2024a). With appropriate implementation of the mitigation measures outlined in Section 6, which include preventing the introduction and spread of weed species and pathogens, it is unlikely that introduction of either diseases listed as harmful to the New Holland Mouse will occur as a direct result of the proposed rezoning.
9. Interfere with the recovery of the species	The National Recovery Plan for the New Holland Mouse (DCCEEW 2024b) outlines objectives for the long term recovery of the species, constituting: • preventing local extinctions • improving genetic diversity • increasing population size • expanding the area of occupancy. As discussed above, the area of the site that is not conferred for biocertification is proposed to be rezoned from Rural Residential (RU2) to Environmental Conservation (C2). Darkinjung also propose to secure the portion of the site to be rezoned to Environmental Conservation under a BSA. By rezoning this portion of the site to a conservation land use and securing it under a BSA, this will ensure this extent of native vegetation which contains potentially suitable habitat for native species, inclusive of the New Holland Mouse, is protected from future development and the biodiversity values will be managed under the requirements of the BSA. Given these provisions, it is unlikely that the proposed rezoning will interfere with any of the aforementioned recovery objectives.

Criteria	Discussion
Conclusion	It is considered unlikely that the proposed rezoning will have a significant impact on the New Holland Mouse as: • There is a low density of occurrence within the footprint and broader locality, therefore it is unlikely that there is a key source population or population necessary for maintaining genetic diversity nor is the footprint near the limit of the species range. As such it is unlikely that the occurrence of potential habitat within the subject land is likely to support an important population. It is considered unlikely that the proposed rezoning would lead to a long-term decrease in an important population of New Holland Mouse. • A considerable amount of potential habitat will remain the locality of the subject land, including directly adjacent to the subject land within land that is proposed for conservation. The subject land has been designed to retain a corridor of vegetation between the two areas proposed for development. Given the relatively small amount of potential habitat to be removed from the locality, it is unlikely that the area of occupancy for an important population would be reduced or an important population fragmented. • A considerable amount of suitable habitat is also present in the broader locality that will be retained, including within land proposed for conservation. The vegetation within the subject land that would be most suitable for the New Holland Mouse is subject to edge effects along a road and is unlikely to be considered as critical. It is unlikely that habitat critical to the survival of the species will be adversely affected by the proposed rezoning. • Though it is considered unlikely an important population is present within the subject land, hygiene measures will be implemented, such as the washing down of vehicles and equipment, to prevent *Phytophthora cinnamomi,* which is known to disrupt the breeding cycle of New Holland Mouse. • Given there is a considerable amount of suitable habitat is also present in the broader locality that will be retained, including within land proposed for conservation, it is unlikely the availability of habitat for the species will be impacted to the extent that the species is likely to decline. • Mitigation measures will be implemented, including controls on domestic pet species and garden plantings to ensure species which are a threat to New Holland Mouse, including feral foxes are cats, do not become established within the subject land and retained adjacent bushland. • Management of feral foxes and cats outlined in the recommended VMP, will help prevent diseases carried by these species from impacting New Holland Mouse. Hygiene practices will be undertaken during contruction to prevent pathogens including *Phytophthora cinnamomi* from being introduced and impacting New Holland Mouse food availability. • The area of the site that is not conferred for biocertification is proposed to be rezoned from Rural Residential (RU2) to Environmental Conservation (C2). Darkinjung also propose to secure the portion of the site to be rezoned to Environmental Conservation under a BSA. By rezoning this portion of the site to a conservation land use and securing it under a BSA, this will ensure this extent of native vegetation which contains potentially suitable habitat for native species, inclusive of the New Holland Mouse, is protected from future development and the biodiversity values will be managed under the requirements of the BSA. Given these provisions, it is unlikely that the proposed rezoning will interfere with any of the aforementioned recovery objectives.

Table E.7 Giant Burrowing Frog

Criteria	Discussion
1. Long-term decrease of an important population	There is approximately 13.3 ha of breeding habitat for the Giant Burrowing Frog within the subject land (Fountain Creek is within 300 m of the subject land), as well as retained areas of Coastal Upland Swamps surrounding the subject land. The species has been recorded during targeted surveys within the subject land conducted by both Umwelt (2020) and EMM. Areas of swamp and woodland within the subject land are well connected and it has been considered that the species is using the entire subject land to both breed and forage. Given this, it is considered likely that the proposed rezoning will lead to a long-term decrease in an important population of the species.

Criteria	Discussion
2. Reduce the area of an important population	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 km x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act. However, considering that the species non-breeding habitat only extends 300 m from breeding sites, and the species has limited mobility, a 300 m x 300 m threshold is more appropriate to this species. The Giant Burrowing Frog is associated with the entirety of the vegetation in the subject land and all of this area is considered to be potential breeding habitat. Therefore, the proposed rezoning could reduce the area of occupancy for an important population of the species.
3. Fragment an important population	The Giant Burrowing Frog is associated with all PCTs on the subject land and has been recorded frequently during surveys. It is predicted to be using the majority of the subject land as well as connected surrounding areas to both breed and forage. The subject land has been designed to retain a corridor of vegetation between the two areas proposed for development to retain connectivity for mobile fauna species. Impacts to connectivity will likely only affect species that are not particularly mobile such as threatened flora species. There will be no substantial loss of fauna movement habitat. Given that connectivity will be maintained between suitable habitat within the subject land and surrounding area, as well as the implementation of the mitigation measures to reduce impact on the Coastal Upland Swamp TEC outlined in Section 6 such as hydrology, weed and runoff management, it is unlikely that the proposed rezoning will fragment an important population of Giant Burrowing Frog.
4. Adversely affect habitat critical to the survival of the species	No critical habitat is defined under the EPBC Act for the Giant Burrowing Frog however the species is described as being dependent upon soaks or pools within first or second order streams surrounded by native forest communities and heathland (DPIE 2020b). The Giant Burrowing Frog is associated with all PCTs within the subject land and in particular the Coastal Upland Swamp TEC. The subject land comprises a matrix of upland swamp patches and woodland habitat. Each mapped area of upland swamp is separated by less than 100 m or would be part of continuous swamp habitat outside of the study area. All records of Giant Burrowing Frog were made along the access track that cuts through the study area, approximately 150 m from surrounding areas of upland swamp habitat, and in the largest gap between patches of upland swamp. It is assumed that Giant Burrowing Frogs could be using all areas of swamp within the study area as breeding habitat, given that all patches are either directly linked or are in proximity. Design iterations of the subject land have reduced the amount of clearing of this TEC to 1.83 ha which will aid in maintaining habitat for the species, however considering the species has been recorded frequently within the subject land, the proposed rezoning is likely to adversely affect habitat critical to the survival of the species.
5. Disrupt the breeding cycle of an important population	It has been assumed that the species is using all areas of swamp within the subject land as breeding habitat and is therefore likely to have some disruptions to the breeding cycle of an important population despite mitigation measures outlined in Section 6.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	As the Giant Burrowing Frog is associated with all PCTs within the subject land, the proposed rezoning will directly reduce suitable foraging and breeding habitat of a known population by 13.32 ha. While mitigation measures in redesigning the subject land have been considered to preserve the most likely areas of this suitable habitat, the species is still at risk of having the availability of suitable habitat reduced to the extent that it is likely to decline.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Predation by European Red Fox and by feral cats are listed as key threatened processes to the Giant Burrowing Frog under the EPBC Act (DCCEEW 2023a). Mitigation measures have been proposed to minimise the risk of invasive species, such as placing controls on domestic pet species and garden plantings, and with appropriate implementation it is unlikely that the proposed rezoning will result in invasive species becoming established in Giant Burrowing Frog habitat.

Criteria	Discussion
8. Introduce disease that may cause the species to decline	The Giant Burrowing Frog is susceptible to *Chytridiomycosis,* an infectious disease caused by the amphibian fungal pathogen (*Batrachochytrium dendrobatidis*). Different amphibian species have varying reactions to this disease ranging from no symptoms at all to mass die-offs and extinction (DoEE 2016). There is not adequate data to ascertain the extent of the disease within the species, however individuals have been recorded as infected in the wild. Susceptibility to this disease is likely to reduce the capacity of the species to deal with other stressors such as the clearing proposed by the proposed rezoning. Mitigation measures such as washdown of vehicles have been proposed to minimise the spread of pathogens within the subject land and surrounding habitats. With appropriate implementation it is unlikely that the proposed rezoning will introduce disease that may cause the species to decline.
9. Interfere with the recovery of the species	No recovery plan for the species is required under the EPBC Act however the Conservation Advice (DCCEEW 2025) for the southern subspecies, *Heleioporus australiacus flavopunctatus*, lists the following recovery actions relevant to the proposed rezoning: • Minimise disturbance to the southern giant burrowing frog at its breeding and nonbreeding sites. • Minimise changes to existing hydrology and maintain appropriate water quality by preventing or minimising water diversion and extraction and preventing pollution. • Ensure that adequate protection measures are in place to protect the viability of subpopulations in areas subjected to forestry or clearing of freehold land and associated management activities. It has been assumed that the species is using most areas of the subject land to both breed and forage. Therefore, the proposed rezoning is considered likely to interfere with the recovery of the species.
Conclusion	It is considered likely that the proposed rezoning will have a significant impact on the Giant Burrowing Frog as: • The species has been recorded during field surveys and is likely to be breeding and foraging throughout much of the subject land. The population within the subject land is therefore considered important and the proposed rezoning could lead to the decrease of this population. • The removal of habitat for the Giant Burrowing Frog for the proposed rezoning will reduce the area of occupancy of an important population of the species. • The subject land has been designed to retain a corridor of vegetation between the two areas proposed for development to retain connectivity for mobile fauna species. Given that connectivity will be maintained between suitable habitat within the subject land and surrounding area, it is considered unlikely that the proposed rezoning would fragment an important population of the species. • Design iterations of the subject land have reduced the amount of clearing of Giant Burrowing Frog habitat which will aid in maintaining ecological support for the species, however the proposal will still remove habitat critical to the survival of the species. • It has been assumed that the species is using all areas of swamp within the subject land as breeding habitat and the proposed rezoning is therefore likely to have some disruptions to the breeding cycle of an important population. • Reduction in foraging and breeding habitat through the removal of known habitat is likely to lead to the species decline in the area. • Mitigation measures have been proposed to minimise the risk of invasive species, such as placing controls on domestic pet species and garden plantings, and with appropriate implementation it is unlikely that the proposed rezoning will result in invasive species becoming established in Giant Burrowing Frog habitat. • Stormwater management will be designed to prevent the quality and quantity of run off into the area proposed for conservation from being impacted. This will aid in the prevention of the spread of the *Chytrid* fungus which affects Giant Burrowing Frog. Therefore, the proposed rezoning is unlikely to disease that may cause the species to decline. • The proposed rezoning is considered likely to interfere with the recovery of the species through the removal of known breeding and foraging habitat.

E.2 Endangered and Critically Endangered species

E.2.1 Mammals

Table E.8 Spotted-tailed Quoll

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	The Spotted-tailed Quoll has not been recorded on the subject land or in the locality. While the species has not been recorded, the vegetation within the subject land does have potential to support the species. Home-range estimates across multiple studies for the species, range from 359 ha to at least 4,186 ha for males, and 88 ha to at least 1,157 ha for females (Claridge et al 2005). The subject land will have a direct impact on 13.4 ha of native vegetation. This is considerably less than the home range of one individual, thus not constituting risk of a long-term decrease in the size of a population.
2. Reduce the area of occupancy of the species	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 km x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act. The proposed rezoning and future development on the site is not expected to reduce habitat for the Spotted-tailed Quoll at this scale. Furthermore, the species has never been recorded in the BCA area nor in the lands of the adjacent national park and state forest. As such, the proposed rezoning is not expected to reduce the area of occupancy of the Spotted-tailed Quoll.
3. Fragment an existing population	There are no records of Spotted-tailed Quoll within the subject land or broader locality. The subject land has been designed to retain a corridor of vegetation between the two areas proposed for development to retain connectivity for mobile fauna species. Impacts to connectivity will likely only affect species that are not particularly mobile such as threatened flora species. There will be no substantial loss of fauna movement habitat. Given this, the proposed development is not likely to fragment an existing population of the species.
4. Adversely affect habitat critical to survival of the species	No critical habitat has been listed for the Spotted-tailed Quoll under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development. As there is no recorded utilisation of the potential habitat in the subject land and the species has never been recorded in the locality, the potential habitat within the subject land is unlikely to constitute habitat critical to the survival of the species. It is therefore unlikely the proposed rezoning will affect habitat critical to the survival of the Spotted-tailed Quoll.
5. Disrupt the breeding cycle of a population	While the vegetation present within the subject land is potentially suitable for the Spotted-tailed Quoll, with habitat features such as tree hollows lower to the ground and fallen logs being potential den sites, the subject land is on the low end of the approximated home range of an individual of the species. Considering this, and the lack of records of the species in the locality, it is unlikely the proposed rezoning will disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	There are no records of Spotted-tailed Quoll within the subject land or broader locality. The subject land has been designed to retain a corridor of vegetation between the two areas proposed for development to retain connectivity for mobile fauna species. Impacts to connectivity will likely only affect species that are not particularly mobile such as threatened flora species. There will be no substantial loss of fauna movement habitat. Considering the home range of an individual of this species, the removal of an area of potential habitat this size is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Criteria	Discussion
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The conservation advice for the Spotted-tailed Quoll (TSSC 2020) defines competitive and/or predatory interactions with wild dogs and foxes as a direct threat to the species. Field surveys did not identify either of these species being present on the subject land. With appropriate implementation of the mitigation measures proposed to minimise the introduction of invasive species to the subject land and surrounding vegetation (refer to Section 6), the proposed rezoning is unlikely to result in invasive species that are harmful to the Spotted-tailed Quoll becoming established.
8. Introduce disease that may cause the species to decline	There are no diseases known to affect the Spotted-tailed Quoll and the proposed rezoning is unlikely to introduce pathogens to the area with the implementation of the proposed mitigation measures (refer to Section 6).
9. Interfere with the recovery of the species	The National Recovery Plan for the Spotted-tailed Quoll lists objectives and actions for the species recovery (DELWP 2016). The following is a subset of objectives relevant to the proposed rezoning: • determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations • reduce the rate of habitat loss and fragmentation on private land. Considering the small extent of potential habitat to be cleared within the subject land and the large home range of the species, it is unlikely that the proposed rezoning will interfere with the recovery of the species.
Conclusion	It is considered unlikely that the proposed rezoning will have a significant impact on the Spotted-tailed Quoll as: • The Spotted-tailed Quoll has not been recorded on the subject land or in the locality although there is suitable potential habitat within the subject land. Nonetheless, given the large home range of the species and large extent of habitat to be proposed for conservation directly adjacent to the subject land, is it unlikely the proposed rezoning will result in the long-term decrease in a population. • No Spotted-tailed Quoll have been recorded within the subject land or broader landscape and the subject land has been designed to maintain a vegetated corridor for mobile fauna species. Therefore, a population is unlikely to be fragmented or have its area of occupancy reduced as a result of the proposal • It is unlikely the proposed rezoning will affect habitat critical to the survival of the Spotted-tailed Quoll given the lack of evidence to suggest the subject land is being utilised by this species. • Potential breeding habitat does occur within the subject land including tree hollows and hollowed logs. However, this species has not been recorded in the subject land or within the broader landscape. Subsequently it was concluded the proposed rezoning is unlikely to disrupt the breeding cycle of a population. • The amount of habitat to be removed, 13.4 ha, is relatively minor considering the home range of the species and therefore the proposed rezoning is unlikely to decrease the availability or quality of habitat to the extent it would lead to a decline in the species. • Implementation of a VMP detailing waste management and pest control methods including exclusion fencing, will aid in prevention of wild dogs and foxes inhabiting retained surrounding habitat. • No diseases are known to impact Spotted-tailed Quoll. Nonetheless, general hygiene protocols will be implemented for the proposed rezoning which will include minimisation and mitigation measures to prevent the spread of disease on the subject land. • It is unlikely that the small scale of clearing will interfere with the recovery of the species given the size of the species' home range.

Table E.9 Large-eared Pied Bat

Criteria	Discussion
1. Long-term decrease in the size of a population	The Large-eared Pied Bat has been recorded both within the subject land as well as the broader locality. EMM surveyed for potential breeding habitat both within the study area and within a buffer of 100 m, searching for potential breeding and roosting habitat in the steepest areas where there was the highest potential for habitat to occur. Even in the steepest areas, there is very minimal rocky habitat within this area, with no suitable caves, overhangs or crevices, and no potential breeding habitat was identified. While breeding habitat was not deemed to be present within the subject land, the conservation advice (DCCEEW 2023b) for the species lists fragmentation of foraging habitat as a key threat to the species survival. Although a maternity roost was not directly identified in proximity to the subject land, suitable habitat to house a maternity roost was identified within 2 km of the study area via LIDAR. Considering this, the recorded presence of the species and suitable foraging habitat within the subject land, it is likely that the proposed rezoning could contribute to the long-term decrease of a population.
2. Reduce the area of occupancy of the species	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 km x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act. The species was recorded within the subject land and in additional to the presence of foraging habitat, there is also suitable breeding habitat within 2 km of the study area. While there will be direct impact to foraging habitat within the subject land, impacts to the potential breeding site would be indirect. Considering the mobility of the species, as well as the level of clearing proposed within the subject land being much smaller than the IUCN threshold it is not expected that the proposed rezoning will reduce the area of occupancy of the Large-Eared Pied Bat.
3. Fragment an existing population	This species has been recorded both within the subject land and broader locality. Additionally, there is potential for suitable breeding habitat to occur within 2 km of the study area, in Strickland State Forest, and the study area contains suitable open woodland habitat. The conservation advice for the species lists fragmentation of foraging habitat as a key threat to the species survival (DCCEEW 2023b). Considering the mobility of the species, and the retention of a vegetated corridor between the two areas proposed for development, the proposed rezoning is not considered likely to fragment an existing population.
4. Adversely affect habitat critical to survival of the species	The species' eligibility for listing and the key threat being the loss, degradation and fragmentation of habitat, particularly foraging habitat, suggests that all habitat for the species either now or at some point in the near future is likely to be critical to the survival of the species (DCCEEW 2023b). Due to records of this species being present historically and recorded during field surveys undertaken by EMM, as well as site suitability for foraging for the species, it is likely that the proposed rezoning will adversely affect habitat critical to the survival of the species.
5. Disrupt breeding cycle of a population	While no suitable breeding habitat was found within the subject land, suitable habitat was identified within 2 km of the subject land in the Strickland State Forest. Considering the direct impact to suitable foraging habitat within the subject land and the proximity of a potential maternity roost for the species, it is possible that the breeding cycle of this population could be disrupted by the proposed rezoning through reduction of foraging habitat as well as noise generated by construction.
6. Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The species was recorded as being present within the subject land both historically and during field surveys undertaken by EMM and suitable foraging habitat is present. Additionally, suitable breeding habitat was identified within 2 km of the subject land which has potential to be associated with this population and foraging habitat. While the amount of direct vegetation clearing associated with the proposed rezoning is relatively low, considering this proximity to potential breeding habitat, it is possible that the proposed rezoning could decrease the availability of habitat for the population to the extent that it is likely to decline.

Criteria	Discussion
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The conservation advice for this species (DCCEEW 2023b) lists invasives species such as goats, foxes and feral cats as a potential threat. These species have not been identified within the subject land and appropriate pest control measures will be implemented to reduce the chance of introduction of invasive species becoming established in the habitat.
8. Introduce disease that may cause the species to decline	This species is potentially at risk of White Nose Syndrome (WNS), which although never detected within Australia, has caused mass mortality of bat populations overseas (DCCEEW 2023b). While the risk for this is low, it is not zero and site hygiene controls will be implemented to reduce the risk of spread of disease.
9. Interfere with the recovery of the species	The National Recovery Plan for the Large-Eared Pied Bat (DERM 2011) lists objectives and actions for the species recovery based on the identified threats to the species. One key threat in the recovery plan is the loss of vegetation in proximity to maternity roosts and their associated foraging habitat with the recovery objectives outlining the reduce this where possible. Although a maternity roost was not directly identified in proximity to the subject land, suitable habitat to house a maternity roost was identified within 2 km. Considering this, the recorded presence of the species within the subject land and suitable foraging habitat within the subject land, it is likely that the proposed rezoning could interfere with the objectives of the recovery plan for this species.
Conclusion	It is considered likely that the proposed rezoning will have a significant impact on the Large-Eared Pied Bat as**:** • No maternity roost was identified in proximity to the subject land, but suitable habitat to house a maternity roost was identified within 2 km. Large-eared Pied Bat was recorded on the subject land and there is suitable foraging habitat present, thus it is likely the proposed rezoning could lead to the long-term decrease of a local population. • Given the mobility of the species and relatively small area of suitable habitat being removed compared with the larger area proposed for conservation to the south of the study area, it is unlikely the area of occupancy will be reduced for Large-eared Pied Bat • Considering the mobility of the species, and the retention of a vegetated corridor between the two areas proposed for development, the proposed rezoning is not considered likely to fragment an existing population. • Large-eared Pied Bat was recorded within the subject land, there is suitable foraging habitat on the subject land and suitable breeding habitat has been identified within 2 km. It is likely the proposed rezoning will adversely affect habitat critical to the survival of the species. This may consequently contribute to the decline of the species within the locality. • Appropriate pest control measures as part of the proposed rezoning will be implemented to reduce the chance of introduction of invasive species becoming established in the habitat and indirectly impacting Large-eared Pied Bat. • Site hygiene controls will be put in place to prevent the risk of diseases being introduced on the subject land and impacting threatened species. • Due to the recorded presence of the species and suitable foraging habitat within the subject land, the proposed rezoning could interfere with the objectives of the recovery plan for this species.

E.2.2 Birds

Table E.10 Swift Parrot

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	Swift Parrots comprise a single population. The current population size is uncertain, however is estimated to be at 750 (range 300 to 1,000) mature individuals (DCCEEW 2024c). The Swift Parrot Recovery Plan (DCCEEW 2024c) has identified 18 key biodiversity areas (KBA) for the Swift Parrot, determined to meet one or more criteria in five categories: threatened biodiversity; geographically restricted biodiversity; ecological integrity; biological processes; and irreplaceability (DCCEEW 2024c). While the subject land is not within any of these KBAs, the site is connected to Brisbane Water National Park which is identified as a KBA and does support the Swift Parrot during autumn and winter. Additionally, Atlas of Living Australia (ALA n.d.) documents a high density of sightings within the broader locality of the subject land, likely in relation to its use of Brisbane Water National Park as a foraging site, although this does indicate the species is not restricted to this KBA and moves sporadically through the locality. However, as Swift Parrots widely disperse during the non-breeding season for foraging, and the subject land is not within a KBA, it is unlikely the loss of 13.4 ha of habitat will lead to the long-term decrease in the population. The species is highly mobile and is widely dispersed throughout NSW during the non-breeding season. Furthermore, large areas of habitat will be retained within the land proposed for conservation outside of the subject land, and within the broader landscape which will continue to provide habitat to support this species.
2. Reduce the area of occupancy of the species	When in NSW, Swift Parrots are widely dispersed, often moving in response to food resource availability. Hence, the loss of 13.4 ha of potential foraging habitat toward the middle of the distribution of the species is unlikely to reduce the area of occupancy for the species.
3. Fragment an existing population	The Swift Parrot is a migratory species that comprises a single population that moves into south-eastern Australia during winter months. Given the relatively small scale of the proposed rezoning when compared to the distribution of the species, combined with the high mobility of the species, the proposed rezoning is unlikely to fragment the population.
4. Adversely affect habitat critical to the survival of the species	*National Recovery Plan for the Swift Parrot* (DCCEEW 2024c) defines habitat critical to the survival of the species as: • areas of priority habitat for which the Swift Parrot has a level of site fidelity • sites that possess phenological characteristics likely to be of importance to the Swift Parrot. The subject land largely lacks Eucalypt species that have a winter flowering phenology, which allows for nectar to be available for Swift Parrot when in southeastern Australia. That is, the Draft National Recovery Plan for the Swift Parrot (DCCEEW 2024c) defines habitat critical to the survival of the species, on the Australian mainland, as known and likely foraging habitat with any (or a combination of) 10 eucalypts, being foraging trees species. Preferred foraging species within known and likely habitats include: • Yellow Gum (*Eucalyptus leucoxylon*) • Red Ironbark (*E. tricarpa*) • Mugga Ironbark (*E. sideroxylon*) • Grey Box (*E. macrocarpa*) • White Box (*E. albens*) • Yellow Box (*E. melliodora*) • Swamp Mahogany (*E. robusta*) • Forest Red Gum (*E. tereticornis*) • Blackbutt (*E. pilularis*) • Spotted Gum (*Corymbia maculata*) (DCCEEW 2024c). These species were not recorded as being present within the subject land. Despite the proximity to the KBA to the south in Brisbane Water National Park, the lack of suitable foraging habitat within the subject land and the small scale of clearing, it is unlikely the proposed rezoning will adversely affect habitat critical to the survival of the species.

Criteria	Discussion
5. Disrupt the breeding cycle of a population	The Swift Parrot only breeds in Tasmania. Therefore, the proposed rezoning is unlikely to disrupt the breeding cycle of the population.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed rezoning and future development of the site is unlikely to reduce the availability of foraging habitat for the species. Considering the lack of preferred foraging tree species for the Swift Parrot within the subject land, it is unlikely that the proposed rezoning will decrease the availability of habitat to the extent that the species is likely to decline.
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The existing landscape is generally in high condition with minimal invasive species with no known species with adverse relationships to the Swift Parrot being present. Given the mitigation measures outlined in Section 6 as well as the lack of foraging habitat for the Swift Parrot, it is considered unlikely that any impacts of the proposed rezoning would facilitate the establishment of further invasive species within the subject land or broader community.
8. Introduce disease that may cause the species to decline	Swift Parrot is susceptible to Psittacine beak and feather disease (PBFD). This disease can remain viable for many years in hollows and nest boxes. However, given Swift Parrot breeds in Tasmania, it is not expected that hollows would be utilised within the subject land. Moreover, given the proposed rezoning does not involve the movement of animals or materials likely to be contaminated by pathogens, the proposed rezoning is considered unlikely to introduce diseases that may cause either species to decline.
9. Interfere with the recovery of the species	The *National Recovery Plan for the Swift Parrot* provides the objectives, strategies, and actions for the recovery of the species. The objective and strategy relevant to the proposed rezoning are (DCCEEW 2024c): • by 2032, maintain or improve the extent, condition and connectivity of habitat of the Swift Parrot • by 2032, anthropogenic threats to Swift Parrot are demonstrably reduced • maintain known Swift Parrot breeding and foraging habitat at the local, regional and landscape scales • protect areas of 'habitat critical to survival' not managed under Regional Forest Agreements from developments (e.g. from residential developments, mining activity, wind and solar farms) and land clearing for agriculture through local, state and Commonwealth Government mechanisms • manage important winter foraging habitat and provide adequate on-going conservation management resources where appropriate (DCCEEW 2024c). Considering the subject land is proximal to and has some connectivity to known Swift Parrot foraging habitat within Brisbane Water National Park, it is possible that the proposal could interfere with the recovery of the species. However, habitat within the subject land is not typical Swift Parrot foraging habitat and clearing of land at the scale of the proposed rezoning is unlikely to have a significant impact to wider connected community.

Criteria	Discussion
Conclusion	It is considered unlikely that the proposed rezoning will have a significant impact on the Swift Parrot as: • The subject land is not within KBA and the removal of habitat within this area is unlikely to lead to a decline in Swift Parrot population, especially given the mobility of the species and wide-spread foraging range within NSW. • The Swift Parrot is a highly mobile species and widely disperses when foraging to seek out autumn and winter flowering eucalyptus each year. It is unlikely a reduction in their area of occupancy would be caused by the proposed rezoning, nor is their population likely to become fragmented. • The habitat present within the subject land is unlikely to be critical to the survival of the species given the lack of key canopy species the Swift Parrot is known to forage on. Therefore, the clearing of vegetation within the subject land will not result in a decline in the species. • The species breeding habitat will not be disrupted given it breeds in Tasmania. • No specific invasive species are known to have an adverse relationship with the Swift Parrot being present. General weed control measures will be put in place to protect the vegetation proposed for conservation to ensure the high condition of habitat within these areas are maintained. • The Swift Parrot is susceptible to Psittacine beak and feather disease (PBFD). This disease can remain viable for many years in hollows and nest boxes. However, given Swift Parrot breed in Tasmania, it is not expected that birds would become infected were they to forage within the subject land or surrounding vegetation. • The recovery of the species is not expected to be impacted by the proposed rezoning. The subject land has sub-optimal foraging habitat given the lack of key canopy feed species. The species is also highly mobile and widely dispersed, enabling it to seek out more preferential feeding grounds within the locality such as Brisbane Water National Park.

E.2.3 Frogs

Table E.11 Littlejohns Tree Frog

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	Littlejohns Tree Frog has well defined areas of reliable occupancy being confined to the Sydney Basin Bioregion, with populations occurring in the Watagans National Park, Blue Mountains National Park, Royal National Park, Dharawal National Park and the Upper Nepean State Conservation Area (DAWE 2022c). Smaller and sparse records also occur throughout the Sydney Basin Bioregion. The closest major population of the species lies approximately 25 km to the north of the subject land in the Watagans National Park and Jilliby State Conservation Area. There is one historical record (ALA n.d.) located 5 km to the north of the subject land, although considering the low density it is not likely to be a source population. The subject land comprises a matrix of upland swamp patches and woodland habitat which could potentially support Littlejohn's Tree Frog. Each mapped area of upland swamp is separated by a distance of less than 100 m or would be part of a continuous swamp outside of the biocertification boundary. However, the lack of smaller order permanent streams within the site indicates that the site is unlikely to be preferred for the species. Considering the sub-optimal habitat in the subject land for the species, the small amount of clearing to occur and the lack of known occurrences of the species in the general locality it is unlikely that the proposed rezoning will lead to a long-term decrease in the size of a local population.

Criteria	Discussion
2. Reduce the area of occupancy of the species	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act. Radio-tracking females for the species showed they mostly stayed within 20 m of breeding sites during breeding activity. It is unknown the distance the species would travel to reach breeding habitat though (DAWE 2022c). The species has been incidentally detected 50 to 100 m from water, but genetic evidence suggests they can move considerable distances with 11 km being recorded between the locations of offspring from the same individual (DAWE 2022c). Based on these findings, a 100 m x 100 m threshold has been selected as an appropriate grid threshold for this species, with the assumption that once an individual frog has reached breeding habitat, it remains within proximity of this space, at least for the breeding season. Littlejohns Tree Frog has not been historically recorded within the subject land and few records exist within the broader locality. As such the proposal is unlikely to reduce the area of occupancy for the species.
3. Fragment an existing population	There is no known existing population within the subject land or within the broader locality. There is one record north in the Ourimbah State Forest, and a significant population further north within the Jilliby State Conservation Area bordering the Watagans Nation Park. The subject land is located at approximately 20 km south of the population in Jilliby State Conservation and approximately 10 km south-east of the Ourimbah record areas. The propoed rezoningl is unlikely to fragment either of those populations.
4. Adversely affect habitat critical to the survival of the species	No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat. Littlejohn's Tree Frog has generally poorly defined habitat preferences, with non-breeding habitat unknown, with the species only found reliably at a few locations, key aspects of breeding habitat critical to survival are generally understood and defined as (DAWE 2022c): • ponds of and area between 1 to 3,000 m² and less than 1.5 m deep • areas of native forest not subject to land clearing • smaller streams (typical below fourth order) with little to no flow and generally associated with upland hanging swamps. The subject land comprises a matrix of upland swamp patches and woodland habitat which could potentially support Littlejohn's Tree Frog. Each mapped area of upland swamp is separated by a distance of less than 100 m or would be part of a continuous swamp outside of the biocertification boundary. However, the lack of smaller order permanent streams within the site indicates that the site only contains sub-optimal habitat for the species. Considering this, the low density of records in the general locality, and lack of historical records within the subject land, it is unlikely that the proposed rezoning will adversely affect habitat critical to the survival of the species.
5. Disrupt the breeding cycle of a population.	There are no records within the subject land and given the lack of smaller order permanent streams within the site, the subject land only contains sub-optimal habitat for the species. Considering this, it is unlikely that the proposed rezoning will disrupt the breeding cycle of the species.,
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Due to the lack of preferred habitat such as smaller order permanent streams within the subject land and the fact there are few historical records in the locality, it is unlikely the proposed rezoning will modify, destroy, remove, isolate or decrease the availability of habitat to the extent that species is likely to decline.
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Littlejohn's Tree Frog are known to be predated upon by fish and potentially by feral cats. The proposal may lead to an increase in feral cat numbers within the local area. Pest management measures are to be put in place via a VMP to prevent potential predation by cats on threatened species. Additionally, the management measures proposed for stormwater runoff and lack of disruption to watercourses in the subject land, will limit the potential of invasive fish species being introduced that may cause the decline of Littlejohn's Tree Frog.

Criteria	Discussion
8. Introduce disease that may cause the species to decline	Littlejohn's Tree Frog is susceptible to Chytridiomycosis, an infectious disease caused by the amphibian fungal pathogen *Batrachochytrium dendrobatidis* (Bd). Different amphibian species have varying reactions to this disease ranging from no symptoms at all to mass die-offs and extinction. Since the species has not been historically recorded near the subject land, and given the management measures proposed, it is unlikely that any disease that may cause the species to decline will be introduced by the proposed rezoning.
9. Interfere with the recovery of the species	There is no approved recovery plan for the species, the conservation advice (DAWE 2022c) is considered to provide sufficient guidance on the recovery of the species. The recovery objectives outlined in this advice relevant to the proposed rezoning include: • minimise disturbance to Littlejohn's Tree Frog and its habitat • minimise the spread of fungus pathogen Bd, the fungus which causes Chytridiomycosis in frogs. Since there are no records of the species in the general locality with the nearest significant population being approximately 25 km north in the Jilly State Conservation Area, and the lack of suitable breeding habitat in the subject land, and given the management measures proposed in this report, it is unlikely the proposed rezoning will interfere with the recovery objectives of the species.
Conclusion	It is considered unlikely that the proposed rezoning will have a significant impact on the Littlejohn's Tree Frog as: • There are very few historical records within the broader locality and a lack of permanent smaller order streams the species requires within the subject land. Therefore, it unlikely the proposed rezoning would lead to a decrease in a local population. • Littlejohn's Tree Frog has not been historically recorded within the subject land and few records exist within the broader locality. As such the proposed rezoning is unlikely to reduce the area of occupancy for the species or fragment an existing local population. • The habitat within the subject land is not considered to be critical to the survival of the species given there is little evidence to suggest the species occurs on the subject land. • The subject land does not contain lower order permanent streams which are required for the species to breed. It is therefore unlikely the clearing of vegetation within the subject land would contribute to the species decline. • Littlejohn's Tree Frog is susceptible to Chytridiomycosis, however it is unlikely the species occurs within the subject land, making it unlikely this disease would be introduced to a local population that would cause it to decline. General hygiene measures will be put in place to limit the introduction of pests and disease to site. • Littlejohn's Tree Frog has not been historically recorded within the subject land and few records exist within the broader locality. The subject land does not contain suitable breeding habitat of lower order permanent streams. The proposed rezoning will thereby not interfere with the recovery of the species.

E.2.4 Flora

Table E.12 Somersby Mintbush

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	The species is restricted to the Somersby Plateau and occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/low scrub. It occurs in both disturbed and undisturbed sites (DPIE 2020b). The population at Reeves Street has been documented in the recovery plan for the species (NPWS 2000) but most previous existing records are further down the slope from the subject land, closer to Fountain Creek. Given that the site contains a matrix of upland swamps and open woodland, much of the subject land provides suitable habitat for this species and is relatively homogenous with respect to Somersby Mintbush habitat. Targeted surveys were undertaken by Umwelt in 2018 and 2019 and by EMM in 2023. There are no known records within the subject land, however there are 29 known records within the adjacent study area just south, which the proposed rezoning seeks to avoid. Threats to Somersby Mintbush as a result of the proposed rezoning include increased runoff and sediment/nutrient loads, the diversion of natural water flows, rubbish and vegetation dumping and weed invasion (TSSC 2016). A number of strategies are to be put in place to limit known threats to Somersby Mintbush impacting the existing population on site (see Section 6). These include appropriate weed prevention measures such as the cleaning of equipment and vehicles on site to minimise weed seed introduction. Stormwater management systems will also help limit weed seed dispersal, as well as present increased runoff and nutrients entering retained areas of bushland. A VMP can detail fencing to be installed to protect the retained habitat to discourage rubbish/vegetation dumping. Monitoring of the Somersby Mintbush population during post-construction to ensure the health of the population is also recommended. Provided the recommended mitigation measures are implemented by the proposed rezoning, a long-term decrease in the local *Prostanthera junonis* population is not anticipated.
2. Reduce the area of occupancy of the species	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 km x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (IUCN 2017). The proposed rezoning is unlikely to the reduce area of occupancy of the species as defined a 2 km x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.
3. Fragment an existing population	The previous biocertification boundary included 29 individuals of the species, part of a known population, however the subject land has been redesigned to avoid all individuals and connected habitat; as such no fragmentation of the existing population is likely.
4. Adversely affect habitat critical to the survival of the species	Somersby Mintbush individuals were located within PCT 3586, Northern Sydney Scribbly Gum Woodland and PCTs 3593 and 3924 are also associated with this threatened species. The proposed rezoning will result in a total of 12.9 ha of these vegetation communities being removed. However, large areas of bushland within the broader site area are to be retained, including the patch of vegetation in which the Somersby Mintbush population is located. The rezoning of the bushland from RU2 to C2 will also guarantee the future protection of the population and connected bushland to the south. Therefore, it is unlikely the removal of 12.9 ha of potentially suitable habitat will adversely affect critical habitat to the survival of the species.
5. Disrupt the breeding cycle of a population	Known populations of the species are generally fragmented by development and are unlikely to disperse between each other however, the reproductive ecology of the species is typical of a colonising species which may assist in its general recovery, meaning any further fragmentation reduces this reproductive possibility even further. This proposed rezoning is not likely to further fragment any population from another and is unlikely to disrupt any potential population dispersal. Additionally, the population will be within an area rezoned as C2, which is likely to improve breeding outcomes in the future, as the population will not be at risk of being fragmented by future development proposals.

Criteria	Discussion
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed rezoning will result in 12.9 ha of potential habitat across three PCTs being removed, that are associated with Somersby Mintbush. However, large areas of bushland within the broader site are to be retained, including the patch of vegetation in which the Somersby Mintbush population is located. The rezoning of the bushland from RU2 to C2 will also guarantee the future protection of the population and connected bushland to the south. Therefore, it unlikely the removal of 12.9 ha of suitable habitat will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The Conservation Advice from the TSSC (2016) lists weed invasion as a threat impacting the Somersby Mintbush. The proposed rezoning may increase the likelihood of weed species being introduced to areas proposed for conservation during the construction and post-construction periods. Mitigation measures, however, are to be put in place such as hygiene practices from the construction team by washing vehicles and equipment down prior to entering the site. A VMP is also recommended to outline the weed control schedule and methods to be undertaken to ensure the conserved bushland is protected. It is therefore unlikely invasive species harmful to the Somersby Mintbush will establish in the species habitat as a result of the proposed rezoning.
8. Introduce disease that may cause the species to decline	The *Prostanthera* genus is susceptible to pathogenic organisms such as *P. cinnamomi* and rootknot nematodes. Road and track construction, vehicle access, vegetation clearing, development and adjacent development, drainage works and high visitation rates all have the potential to increase the likelihood of infection (NPWS 2000b). While there are no individuals within the subject land, mitigation measures outlined in Section 6 pertaining to the management of weeds and stormwater run-off, will help to ensure harmful pathogens are unlikely to be introduced to the known recorded population south of the subject land.
9. Interfere with the recovery of the species	The overall objective of the recovery plan (NPWS 2000b) is to identify policies and programs which protect and conserve Somersby Mintbush and which reduce the risk of extinction of the species. Specific objectives of the plan relevant to this proposed rezoning are: • ensuring that Somersby Mintbush populations are not destroyed as a consequence of habitat loss, and that an increased level of security is provided over lands which support Somersby Mintbush populations • minimising the risk of Somersby Mintbush populations from declining in the long term through encouraging the implementation of appropriate threat and habitat management practices. Initially, the subject land included 29 individuals of Somersby Mintbush. The subject land has since been redesigned in line with the objectives of the species recovery plan to completely exclude these individuals. Considering this redesign, as well as the already fragmented nature of the species distribution meaning it is unlikely to reduce connectivity, it is unlikely that this proposed rezoning will interfere with the objectives of the recovery plan. Furthermore, the re-zoning of the remainder of the site to the south will ensure the future conservation of the known recorded population.
Conclusion	It is considered unlikely that the proposed rezoning will have a significant impact on the Somersby Mintbush as: • Targeted surveys by Umwelt and EMM located 29 known records of Somersby Mintbush within the study area. The proposed rezoning has been designed to avoid this population. • The recorded population will be located in an area which is to be rezoned as C2 from RU2, providing greater protection from future impacts. This will limit the likelihood of the population becoming fragmented and potentially lead to improved outcomes for the breeding cycle of the species. • Vegetation clearing of 12.9 ha across three PCTs within the subject land will result in removal of potential suitable habitat for Somersby Mintbush. However, it is unlikely this vegetation is critical to the survival of the species. The avoidance of the recorded population and its connection to large areas of bushland within the broader site to the south, should ensure the future protection of the species in the local area. • The mitigation measures in Section 6 list actions which will help protect the Somersby Mintbush from being impacted indirectly by the proposed rezoning including hygiene practices, stormwater management design, and weed control. • The rezoning of large areas of RU2 land to C2 should allow for the future protection of the local population of Somersby Mintbush on site, which is in line with the objectives of the species recovery plan.

E.2.5 Endangered ecological communities

Table E.13 Coastal Upland Swamps in the Sydney Basin Bioregion

Criteria	Discussion
1. Reduce the extent of the ecological community	There is 1.83 ha of PCT 3924 *Sydney Coastal Upland Swamp* located within the subject land, all of which has been considered as consistent with the *Coastal Upland Swamps in the Sydney Basin Bioregion* EEC. According to the Final Determination, approximately 5360 ha of Coastal Upland Swamp in the Sydney Basin Bioregion has been mapped based on an amalgamation of best available regional vegetation mapping throughout the range of the community (TSSC 2012). Therefore, approximately 0.034% of this EEC is to be cleared as a result of the proposed rezoningl. The main potential for indirect impacts to Coastal Upland Swamp EEC may occur through changes in hydrology, particularly a decrease in run-off leading to drying, or concentration of run-off leading to nick points and erosion. There is also the potential for high threat weed species to be introduced and changes in nutrient loads. Prevention of runoff from future residential development into intact vegetation downslope will be significant in maintaining the integrity of the Coastal Upland Swamp EEC. Protection measures for this EEC were the key driver for the redesign of the subject land which reduced the impact area from 7.53 ha to 1.83 ha, thus avoiding the main area of intact swamp at the western end of the site. Further mitigation measures are outlined in Section 6 such as detailed run off prevention and control and retention of buffers of intact vegetation around the EEC where possible. Though secure mitigation measures have been proposed to reduce the likelihood of indirect impacts through hydrology changes to the site and the proposed rezoning has been redesigned to impact a much smaller designation of the EEC, the proposed rezoning will still reduce the extent of the ecological community.
2. Fragment or increase fragmentation	Impacts to connectivity are considered to be minor, given that the subject land is located at the edge of a larger patch of bushland, as well as being located adjacent to Reeves Street, with the road already acting as a pre-existing barrier for connectivity to the north. Additionally, lots on the northern side of Reeves Street have predominately been cleared, particular those to the north-west. The subject land has been designed to leave a corridor of intact vegetation between the two areas proposed for future development, which will help to maintain connectivity between areas to the north and south of the subject land (Figure 6.1), Furthermore, the subject land has been placed to ensure that the regional biodiversity corridor that lies to the east of the subject land remains most unaffected , retaining connectivity between the site and the intact vegetation on the northern side of Reeves Street, connected to Strickland State Forest. It is assumed based on aerial imagery and vegetation modelling, that the corridor of intact vegetation consists of patches of Coastal Upland Swamp. Therefore, the level of connectivity from the site to vegetation in the north will be maintained through this corridor and will not change, and the EEC will not be fragmented.

Criteria	Discussion
3. Adversely affect habitat critical to survival of the ecological community	The conservation advice (DoE 2014) for the EEC does not explicitly define habitat that is critical to the survival of the community however it can be generally described as areas that are necessary: • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the ecological community) • for the recovery of the ecological community. The proposed has been designed to limit the level of clearing of this EEC by reducing it from 7.53 ha to 1.83 ha. Given the large area of bushland proposed to be rezoned for conservation, it is unlikely the removal of a relatively small area of EEC will adversely affect the survival of the ecological community. The retained areas of EEC are to be further protected by the rezoning of land from RU2 to C2 which will limit the types of development which are permissible within this area. The main potential for impacts to conserving Coastal Upland Swamp EEC are through indirect impacts due to potential changes in hydrology at the site, particularly a decrease in run-off leading to drying, or concentration of run-off leading to nick points and erosion. There is also the potential for changes to upland swamps due to invasive species and changes in nutrient loads. A number of mitigation measures (Section 6) are proposed such as the placement of stormwater systems within the subject land, ensuring a buffer between wastewater systems and the EEC and weed control measures through an established VMP. This impact is also mitigated by the intentional selection of the Environmental Living zoning (C4), as opposed to other residential zoning types that have higher potential for impact due to higher density. Provided these strategies are followed it is unlikely the proposed rezoning will impact habitat critical to the survival of the EEC in the locality.
4. 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	The main potential for indirect impacts to Coastal Upland Swamp EEC will occur due to changes in hydrology at the site, particularly a decrease in run-off leading to drying, or concentration of run-off leading to nick points and erosion. There is also the potential for changes to upland swamps due to invasive species and changes in nutrient loads. As long as the proposed mitigation measures are implemented for stormwater and management to control runoff and nutrient loading from residential development, it is unlikely the Coastal Upland Swamp EEC will be impacted in a way which impacts its survival.
5. 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	Areas of Coastal Upland Swamp EEC in and around the subject land are particularly susceptible to changes in surface and groundwater flows. Avoidance measures to prevent hydrological impacts to the EEC will be placed within the subject land such as stormwater and waste management systems which would be placed at a distance from areas of the EEC will be implemented. Vulnerable species associated with the EEC such as the Giant Burrowing Frog have been recorded within the subject land and have been assumed to use the majority of the site for breeding. Changes in hydrology have the potential to reduce the viability of habitat for this species through degradation of the EEC, which relies on specific water regimes and water quality for its functioning. However, the proposed stormwater protection measures outlined in Section 6 such as stormwater management systems, as well as strategic zoning to environmental living as opposed to higher density options, will be implemented so that it is unlikely there will be substantial change in the species composition or decline in functionality of the EEC.

Criteria	Discussion
6. 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	Considering the mitigation measures, including hygiene practices to prevent the introduction of weeds on site, as well as weed control strategies to be undertaken under a VMP, it is unlikely that any invasive species that are harmful to the ecological community will become established. Stormwater management systems are to be put in place to prevent runoff impacting adjacent conserved areas of EEC. The proposed rezoning is unlikely to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the EEC given the subject land is proposed to be zoned for residential purpose.
7. Interfere with recovery of the ecological community	There is no approved state or national recovery plan, however management prescriptions for the EEC exists within NSW Parks and Wildlife Plans of Management for the following areas relevant to the development: • Brisbane Water National Park • Ku-Ring-Ga Chase National Park. The conservation advice (DoE 2014) summarises priority recovery and threat abatement actions and the following are relevant to the development: • Protect and conserve remaining areas of the ecological community. • Avoid disturbances to hydrology that may result in changes to the natural hydrological regime of the community. The overall redesign of the subject land in response to the presence of the EEC aims to protect and conserve the remaining areas of the community, although minor clearing (1.83 ha) will occur. The mitigation measures proposed for the proposed rezoning seek to avoid disturbances to the hydrology of the site by implementing strategic run off and wastewater management plans, seeking advice from further groundwater and hydrology assessment to occur during the development stage. The implementation of mitigation measures mentioned in Section 6, as well as any impacts on water quality or hydrological processes are unlikely to occur beyond the subject land and interfere with the recovering of the ecological community beyond the subject land. Large areas of the EEC will be retained within the broader site, outside the subject land with conserved areas being rezoned from RU2 to C2 allowing for their future protection by limiting the types of development which are permissible.

Criteria	Discussion
Conclusion	It is considered unlikely that the proposed rezoning will have a significant impact on the Coastal Upland Swamp EEC as: • The proposed rezoning will result in a reduction in the extent of EEC by 1.83 ha. However, this will amount to only a 0.034% reduction in the total estimated extent of the EEC (TSSC 2012). Large areas of the EEC will be retained within the broader site, outside the subject land with conserved areas being rezoned from RU2 to C2 allowing for their future protection by limiting the types of development which are permissible. • The EEC will not be fragmented as the subject land has been situated on the edge of the site adjacent to a road. Connectivity will still exist between the broader site and bushland to the north in Strickland State Forest. • A number of mitigation measures are to be put in place to protect the EEC in the broader site. These include stormwater management design, hygiene practices during construction and implementation of a VMP for weed control, all of which will help prevent invasive species becoming established in the EEC. • The protection of the EEC through rezoning, as well as mitigation measures such as stormwater management will subsequently protect threatened fauna species which rely on this community including Giant Burrowing Frog. • Weed control measures are to be established by the implementation of a VMP and hygiene practices during construction to protect conserved areas of EEC. • Mitigation measures are also to be put in place to avoid disturbances to the hydrology of retained areas from the subject land. The protection of the majority of the EEC in the site and the management of hydrology to avoid disturbance from development, both follow the conservation advice set out by the DoE(2014b).

Australia

SYDNEY
Ground floor 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE
Level 3 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE
Level 1 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA
Suite 2.04 Level 2
15 London Circuit
Canberra City ACT 2601

ADELAIDE
Level 4 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE
Suite 9.01 Level 9
454 Collins Street
Melbourne VIC 3000
T 03 9993 1900

PERTH
Suite 3.03
111 St Georges Terrace
Perth WA 6000
T 08 6430 4800

Canada

TORONTO
2345 Yonge Street Suite 300
Toronto ON M4P 2E5
T 647 467 1605

VANCOUVER
422 Richards Street Unit 170
Vancouver BC V6B 2Z4
T 604 999 8297

CALGARY
700 2nd Street SW Floor 19
Calgary AB T2P 2W2

linkedin.com/company/emm-consulting-pty-limited

emmconsulting.com.au