Transport for NSW

Redfern North Eveleigh Precinct Renewal

Ecology Assessment - Paint Shop Sub-Precinct

JUNE 2022

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Redfern North Eveleigh Precinct Renewal
Ecology Assessment - Paint Shop Sub-Precinct

Transport for NSW

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REV	DATE	DETAILS
A	20.10.21	For client review
B	26.01.21	Revision following client review and addition of urban biodiversity principles
C-F	19.11.21	Revision following client review
G	5.04.22	Update following Masterplan modification

	NAME	DATE	SIGNATURE
Prepared by:	Lukas Clews	20.10.21	
Reviewed by:	Josie Stokes	20.10.21	
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Revision prepared by:	Briony Mitchell	26.10.21	
Reviewed and approved by:	Rodney van der Ree	26.10.21	
Revision C/F prepared by:	Briony Mitchell	19.11.21	
Reviewed and approved by:	Rodney van der Ree	25.11.21	
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Updated by:	Briony Mitchell	15.05.2022	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

Table of contents

Abbreviations

BAM	Biodiversity Assessment Method 2020
BAM-C	Biodiversity Assessment Method Calculator
BAR	Biodiversity Assessment Report
BDAR	Biodiversity Development Assessment Report
BC Act	NSW *Biodiversity Conservation Act 2016*
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
DBH	Diameter at breast height
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EES Group	Environment, Energy and Science Group (EES) - a division of Planning Industry and Environment, supersedes NSW Office of Environment and Heritage (OEH)
Ha	Hectares
HT	High Threat
IBRA	Interim Biogeographically Regionalisation of Australia
km	Kilometre
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (OEH, 2017).
MNES	Commonwealth Matters of National Environmental Significance
PCT	Plant Community Type
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that are assessed in accordance with section 6.4. of the BAM
TfNSW	Transport for New South Wales
TEC	Threatened Ecological Community
WONS	Weeds of National Environmental Significance

VZ	Vegetation Zone

1 Introduction

The NSW Government is investing in the renewal of the Redfern North Eveleigh Precinct to create a unique mixed-use development, located within the important heritage fabric of North Eveleigh. The strategic underpinning of this proposal arises from the Greater Sydney Region Plan and District Plan. These Plans focus on the integration of transport and land use planning, supporting the creation of jobs, housing and services to grow a strong and competitive Sydney.

The Redfern North Eveleigh Precinct is one of the most connected areas in Sydney, and will be a key location for Tech Central, planned to be Australia's biggest technology and innovation hub. Following the upgrading of Redfern station currently underway, the Precinct's renewal is aimed at creating a connected destination for living and working, and an inclusive, active and sustainable place around the clock.

The Redfern North Eveleigh Precinct comprises three Sub-Precincts, each with its own distinct character:

- The Paint Shop Sub-Precinct which is the subject of this rezoning proposal;
- The Carriageworks Sub-Precinct, reflecting the cultural heart of the Precinct where current uses will be retained; and
- The Clothing Store Sub-Precinct which is not subject to this rezoning proposal.

This State Significant Precinct (SSP) Study proposes amendments to the planning controls applicable to the Paint Shop Sub-Precinct to reflect changes in the strategic direction for the Sub-Precinct. The amendment is being undertaken as a State-led rezoning process, reflecting its status as part of a State Significant Precinct located within the State Environmental Planning Policy (Precincts - Eastern Harbour City) 2021.

The amended development controls will be located within the City of Sydney Local Environmental Plan. Study Requirements were issued by NSW Department of Planning and Environment (DPE) in December 2020 to guide the investigations to support the proposed new planning controls.

1.1 Purpse of this report

The purpose of this report is to provide a detailed ecological review of the proposed changes, and consider any potential impacts that may result within and surrounding the Paint Shop Sub-precinct. This report addresses study requirements; the Ecological Assessment (9.1b) and considerations that are part of section 9.1 – Green infrastructure, Ecology and Urban Forest relating to creating urban biodiversity and habitat linkages. The relevant study requirements, considerations and consultation requirements, and location of where these have been responded to is outlined in Table 1.1 below.

This Biodiversity Assessment Report (BAR) (i.e. the Ecological Assessment – 9.1b) presents the results of the ecological assessment based on desktop review and survey and considers any potential impacts on biodiversity that may result within and surrounding the Paint Shop Sub-precinct as a result of the proposal. This report will also support other specialists undertaking the Urban Forest and Greening scopes.

Table 1.1 Study requirements, consideration and consultation requirements

REF	STUDY REQUIREMENT	SECTION (AND PAGE NUMBER) OF THIS REPORT
STUDY REQUIREMENTS		
9.1b	Ecological Assessment	Section 3, 4 and 5: — Pages 18 - 31
CONSIDERATIONS (PART OF 9.1 – GREEN INFRASTRUCTURE ECOLOGY AND URBAN FOREST)		
9.1a	Impacts on biodiversity and measures to avoid and minimise impacts, protect and enhance biodiversity	Sections 4, 5 and 9: — Impacts: pages 28-31 — Enhancing biodiversity: pages 35- 46
9.1	The potential habitat linkage provided by the railway corridor outlined in the City's Urban Ecology Strategic Action Plan, currently under review as an important biodiversity corridor	Sections 3.10, 7 and 9: — Pages 26 and 37 — Pages 32 and 33 — Pages 35 - 46
	The use of a diversity of local native plant species in street tree planting, open space areas and any site landscaping	Section 9: — Page 36 - 40
CONSULTATION		
9.1	City of Sydney (CoS) to inform opportunities for Urban Biodiversity Sensitive Design	Section 8 and 9: — Page 34 — Pages 35 - 46

Source: High Level Program Consultant Review v20210917 Excel file

1.2 Redfern North Eveleigh Precinct

The Redfern North Eveleigh Precinct is located approximately 3km south-west of the Sydney CBD in the suburb of Eveleigh (refer to Figure 1.1). It is located entirely within the City of Sydney local government area (LGA) on government-owned land. The Precinct has an approximate gross site area of 10.95 hectares and comprises land bounded by Wilson Street and residential uses to the north, an active railway corridor to the south, residential uses and Macdonaldtown Station to the west, and Redfern station located immediately to the east of the Precinct. The Precinct is also centrally located close to well-known destinations including Sydney University, Victoria Park, Royal Prince Alfred Hospital, the University of Technology, Sydney and South Eveleigh, as part of the broader Tech Central District.

The Precinct is located within the State Heritage-listed curtilage of Eveleigh Railway Workshops and currently comprises the Platform Apartments with 88 private dwellings, Sydney Trains infrastructure and key state heritage buildings including the Paint Shop, Chief Mechanical Engineer's Building, and the Carriageworks and Blacksmith Shop which provide shared community spaces for events including the Carriageworks Farmers Markets.

A map of the precinct and relevant boundaries is illustrated in Figure 1.2

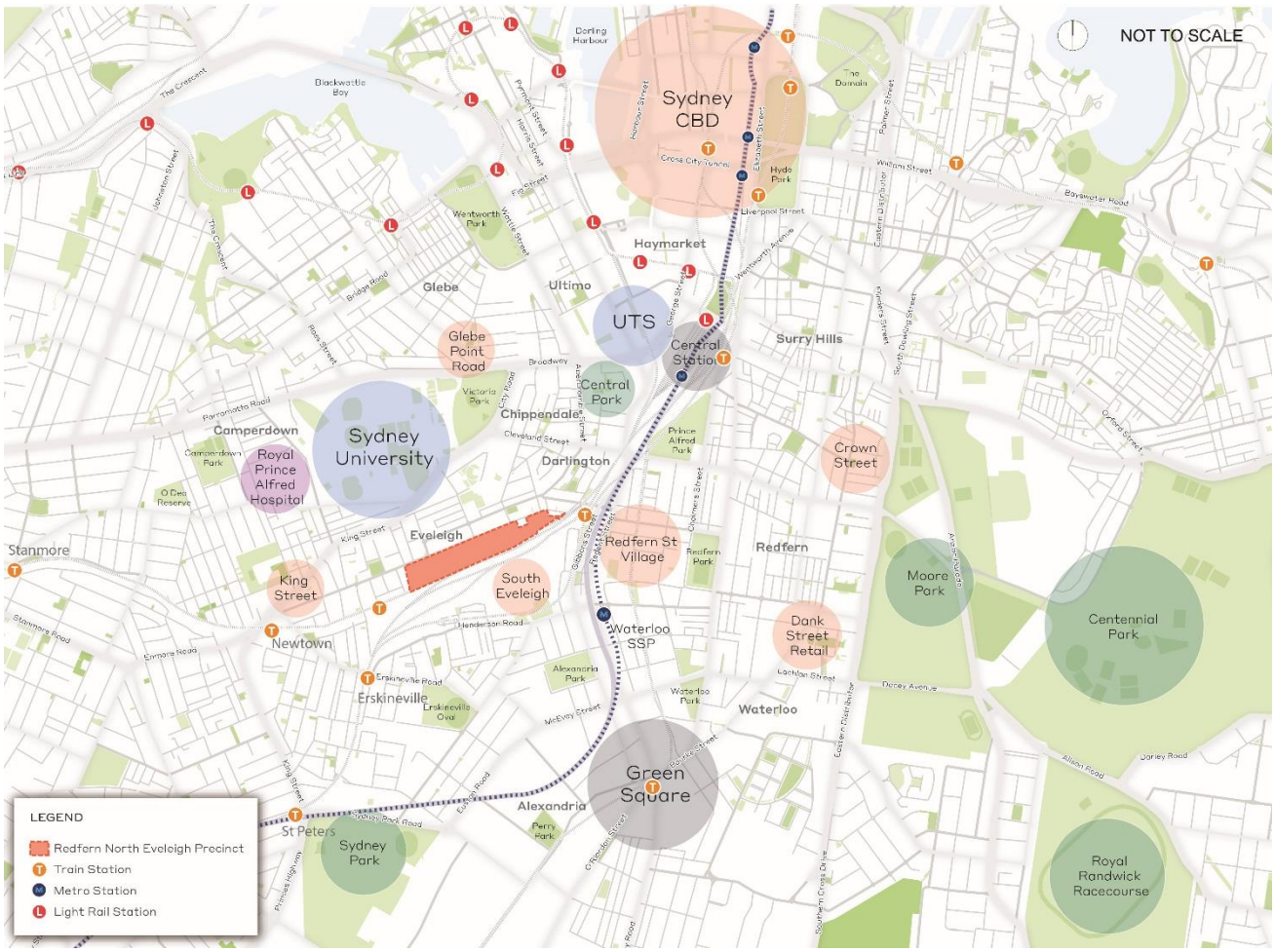

Figure 1.1 Location plan of Redfern North Eveleigh Precinct

Source: Ethos Urban

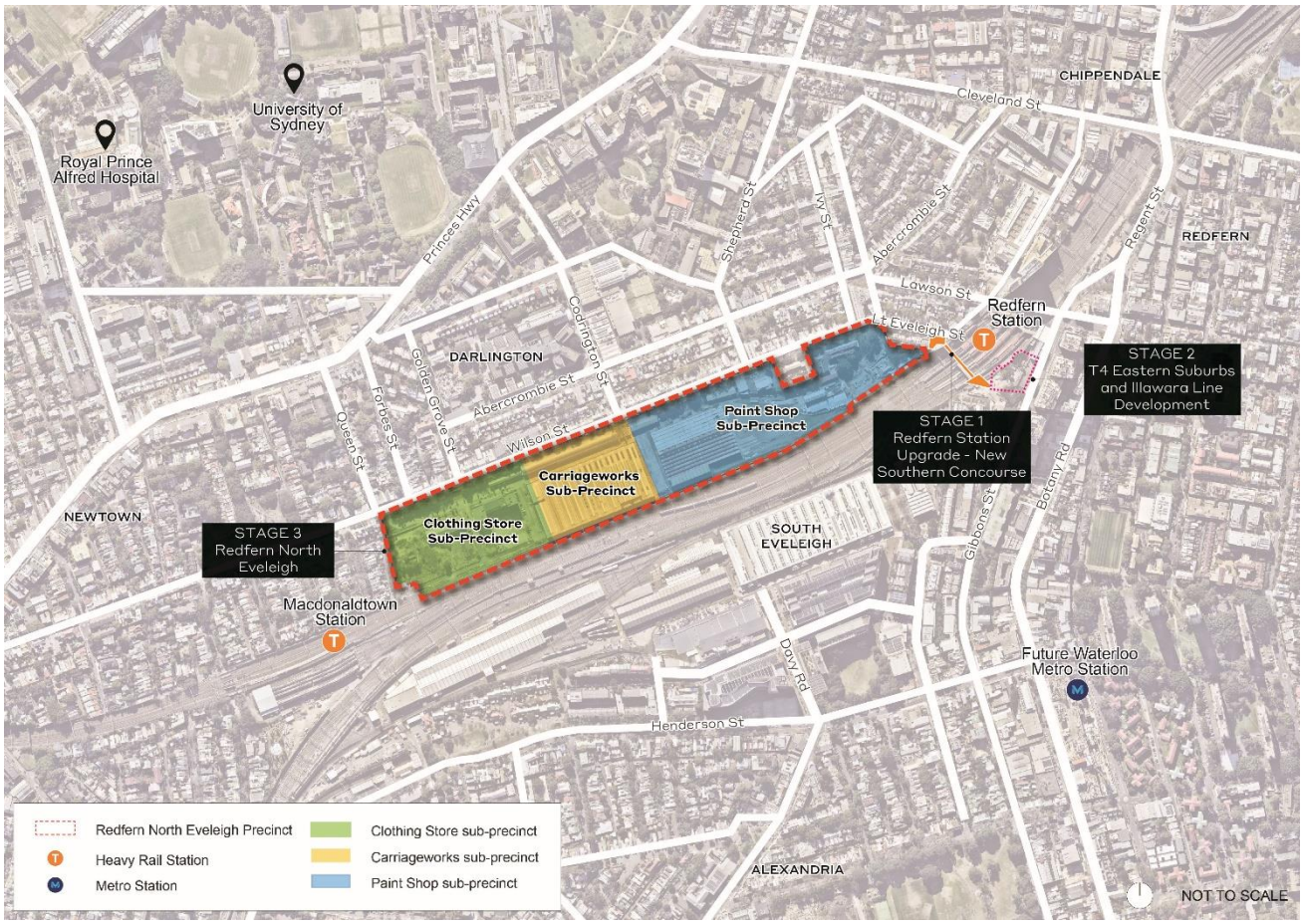

Figure 1.2 Redfern North Eveleigh and Sub-Precincts

Source: Ethos Urban

1.3 Redfern North Eveleigh Paint Shop Sub-Precinct

The Redfern North Eveleigh Paint Shop Sub-Precinct is approximately 5.15 hectares and is bounded by Wilson Street to the north, residential terraces and Redfern station to the east, the Western Line rail corridor to the south and the Carriageworks Sub-Precinct to the west. The Sub-Precinct has a significant level change from a Reduced Level (RL) height of RL25 metres to RL29 metres on Wilson Street.

The Paint Shop Sub-Precinct currently hosts a number of items of heritage significance, including the Paint Shop Building, Fan of Tracks, Science Lab Building, Telecommunications Building, and Chief Mechanical Engineer's Building. The Sub-Precinct has a number of disused spaces adjacent to the rail corridor as well as functioning Sydney Trains' infrastructure, offices and operational space. Vehicle and pedestrian access to this area is used by Sydney Trains. The site has a clear visual relationship to South Eveleigh and the Eveleigh Locomotive Workshops across the active rail corridor.

A map of the Paint Shop Sub-Precinct and relevant boundaries is illustrated in Figure 1.2.

1.4 Renewal Vision

The Redfern North Eveleigh Paint Shop Sub-Precinct will be a connected centre for living, creativity and employment opportunities that support the jobs of the future, as well as providing an inclusive, active and sustainable place for everyone, where communities gather.

Next to one of the busiest train stations in NSW, the Sub-Precinct will comprise a dynamic mix of uses including housing, creative and office spaces, retail, local business, social enterprise and open space. Renewal will draw on the past, adaptively re-using heritage buildings in the Sub-Precinct and will acknowledge Redfern's existing character and particular significance to Aboriginal peoples, culture and communities across Australia. The Sub-Precinct will evolve as a local place contributing to a global context.

1.5 Project Description

An Urban Design and Public Domain Study has been prepared to establish the urban design framework for the Redfern North Eveleigh Paint Shop Sub-Precinct. The Urban Design and Public Domain Study provides a comprehensive urban design vision and strategy to guide future development of the Sub-Precinct and has informed the proposed planning framework of the SSP Study.

The Urban Design Framework for the Paint Shop Sub-Precinct comprises:

- Approximately 1.4 hectares of publicly accessible open space, comprising:
  - A public square – a 7,910 square metre public square fronting Wilson Street;
  - An eastern park – a 3,871 square metre park located adjacent to the Chief Mechanical Engineer's Building and the new eastern entry from Platform 1 of the Redfern station; and
  - Traverser No1 - a 2,525 square metre public square edged by Carriageworks and the Paint Shop.
- Retention of over 90% of existing high value trees.
- An overall greening coverage of 40% of the Sub-Precinct.
- A maximum of 142,650 square metre gross floor area (GFA), comprising:
  - between 103,700 - 109,550 square metres of gross floor area (GFA) for employment and community facility floor space (minimum 2,500 square metres). This will support approximately 6,200 direct jobs on the site across numerous industries including the innovation, commercial and creative sectors.

- between 33,100 - 38,950 square metres of GFA for residential accommodation, providing for between 381 and 449 new homes (including 15% for the purposes of affordable housing).

- New active transport infrastructure and routes to better connect the Paint Shop Sub-Precinct with other parts of Tech Central and the surrounding localities.
- Direct pedestrian connections to the new Southern Concourse at Redfern station.
- Residential parking rates, comprising:
  - Studio at 0.1 per dwelling
  - 1 Bed at 0.3 per dwelling
  - 2 Bed at 0.7 per dwelling
  - 3 Bed at 1.0 per dwelling
- Non-residential car parking spaces (including disabled and car share) are to be provided at a rate of 1 space per 700 square metres of GFA.
- 66 car spaces are designated for Sydney Trains maintenance and operational use.

The key features of the Urban Design Framework, include:

- The creation of a new public square with direct pedestrian access from Wilson Street to provide a new social and urban hub to promote outdoor gatherings that will accommodate break out spaces and a pavilion structure.
- An eastern park with direct access from Redfern station and Little Eveleigh Street, which will provide a high amenity public space with good sunlight access, comfortable wind conditions and community character.
- Upgraded spatial quality of the Traverser No1 yard, retaining the heritage setting, and incorporating complementary uses and good access along Wilson Street to serve as a cultural linkage between Carriageworks and the Paint Shop Building.
- The establishment of an east-west pedestrian thoroughfare with new public domain and pedestrian links.
- A range of Water Sensitive Urban Design (WSUD) features.
- Activated ground level frontages with commercial, retail, food and beverage and community and cultural uses.
- Adaptive reuse of heritage buildings for employment, cultural and community uses.
- New buildings for the Sub-Precinct, including:
  - Commercial buildings along the rail corridor that range between 3 and 26 occupied storeys;
  - Mixed use buildings along the rail corridor, comprising a three-storey non-residential podium with residential towers ranging between 18 to 28 occupied storeys;
  - Mixed use buildings (commercial and residential uses) along Wilson Street with a four-storey street wall fronting Wilson Street and upper levels at a maximum of 9 occupied storeys that are set back from the street wall alignment;
  - A commercial building on the corner of Wilson Street and Traverser No.1 with a four-storey street wall fronting Wilson Street and upper levels at a maximum of 8 occupied storeys that are set back from the street wall alignment. There is flexibility to allow this building to transition to a mixed-use building with active uses at ground level and residential uses above; and
  - Potential options for an addition to the Paint Shop Building comprising of commercial uses. These options (all providing for the same GFA) include:

- A 5-storey commercial addition to the Paint Shop Building with a 3m vertical clearance, with the adjacent development site to the east comprising a standalone 3-storey commercial building (represented in Figure 3);
- A 3-storey commercial addition to the Paint Shop Building with a 3m vertical clearance which extends and connects to the commercial building on the adjacent development site to the east; and
- No addition to the Paint Shop Building, with the adjacent development site to the east comprising a standalone 12-storey commercial building.

- Commitment to a 5 Star Green Star Communities rating, with minimum 5 Star Green Star Buildings rating.
- All proposed buildings are below the Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) to ensure Sydney Airport operations remain unaffected.

The proposed land allocation for the Paint Shop Sub-Precinct is described in Table 1.2 below.

Table 1.2 Breakdown of allocation of land within the Paint Shop dub-precinct.

LAND ALLOCATION	EXISTING	PROPOSED
Developed area	15,723 sqm / 30% of total site area	20,824 sqm / 40% of total site area
Public open space	Area not publicly accessible	14,306 sqm / 28% of total site area
Other public domain areas (including streets, shared zones, pedestrian paths and vehicular zones)	Area not publicly accessible	15,149 sqm / 29% of total site area (Excludes privately accessible public links and private spaces ~ 3% of total site area)

The Indicative Concept Proposal for the Paint Shop Sub-Precinct is illustrated in Figure 1.3 below.

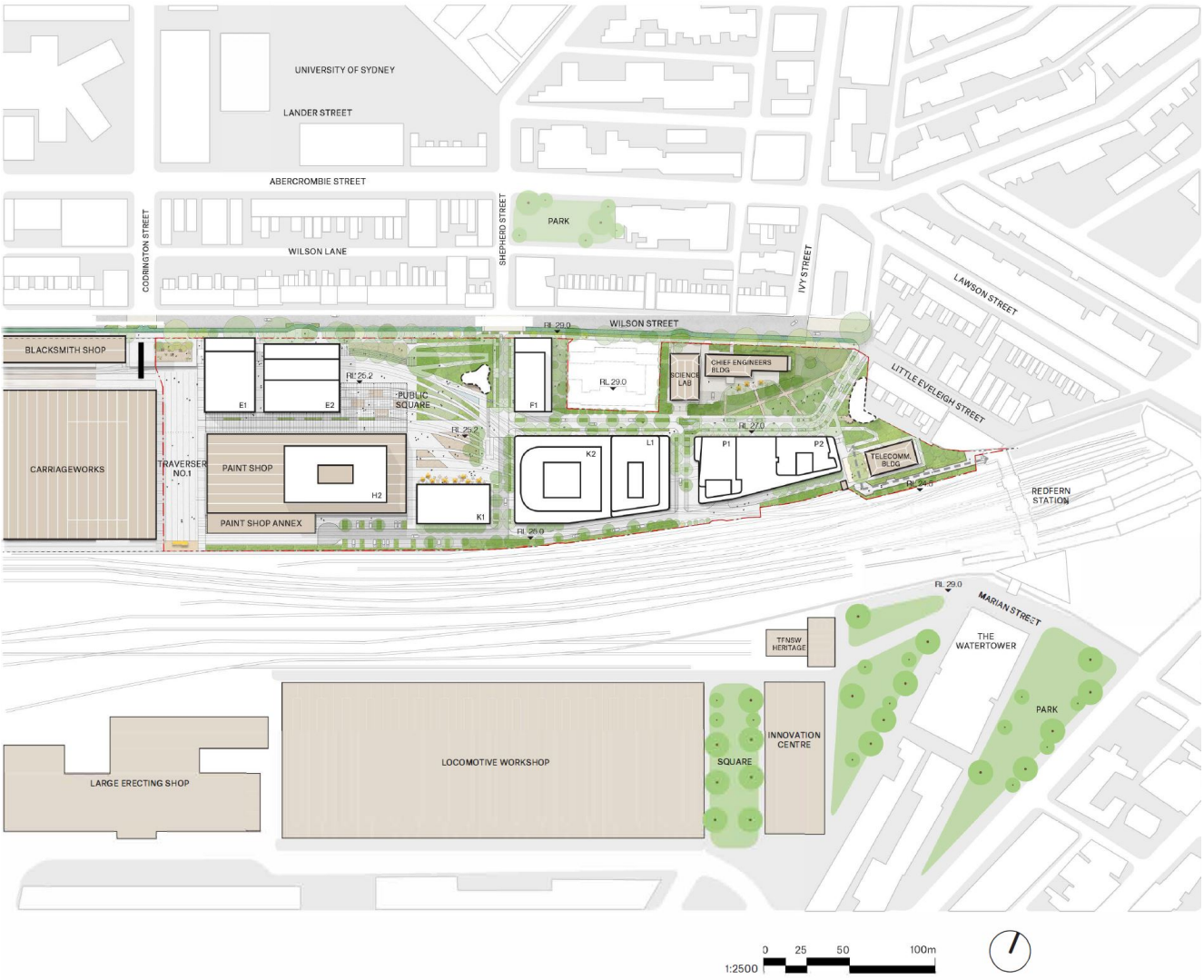

Figure 1.3 Indicative Concept Proposal

Source: Bates Smart and Turf

1.6 Legislative Context

The urban design framework for the Redfern North Eveleigh Paint Shop sub-precinct forms part of the Redfern North Eveleigh Precinct urban renewal project. The site is currently zoned as Business-mixed use, and TfNSW are seeking to amend the development controls. This Ecology Assessment has been prepared to support the proposal to amend the development controls. Further assessment will be undertaken prior to lodgement of any development applications.

Relevant legislation considered for this assessment includes:

- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)
- NSW *Biodiversity Conservation Act 2016* (BC Act)
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- NSW *Local Land Services Act 2013* (LLS Act).

2 Methods

The following methods have been undertaken in the preparation of this Biodiversity Assessment Report in accordance with the Biodiversity Assessment Method (BAM) 2020. All work was carried out under the appropriate licences, including a scientific licence as required under Part 2 of the BC Act (Licence Number: SL100630) and an Animal Research Authority issued by the DPI Agriculture).

2.1 Personnel

The contributors to the preparation of this report, their qualifications and roles are provided in Table 2.1.

Table 2.1 Personnel, role and qualifications

NAME	ROLE	QUALIFICATIONS
Dr Rodney van der Ree	National Technical Executive – technical lead	Bachelor of Science (1st class Hons) Doctor of Philosophy, Deakin University
Lukas Clews	Principal Ecologist (flora)- field survey and reporting, accredited BAM assessor BAAS17060	Bachelor of Science
Josie Stokes	Principal Ecologist (fauna) - field survey and technical review	Bachelor of Science
Briony Mitchell	Senior Ecologist - reporting	Bachelor of Science (hons - Conservation Ecology)
Sebastian Miller	Ecologist – field survey and reporting	Bachelor of Marine Science (Biology)

2.2 Nomenclature

Names of vegetation communities used in this report are based on the Plant Community Types (PCTs) used in the NSW BioNet Vegetation Classification Database (EES, 2020). These names are cross-referenced with those used for Threatened Ecological Communities (TECs) listed under the BC Act and/or the EPBC Act.
Names of plants used in this report follow PlantNET (Royal Botanic Gardens, 2020). Scientific names are used in this report for species of plant. Scientific and common names (where available) are provided throughout the report. The names of introduced species are denoted with an asterisk (*).

2.3 Study Area

The study area for this current Ecology Assessment, including field survey, is the Paint Shop Sub-precinct shown in Figure 2.2. To highlight the local landscape, a 5km and 10km radial buffer as shown in Figure 2.2 were used for the Background Research database searches. A 50km radial buffer in comparison to the study area is shown in Figure 2.3.

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RNE Ecology Assessment

Figure 1
Site Location

Paint Shop Sub-Precinct

Redfern Precinct

0 150 300
Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:10,000 Date: 13/10/2021

Data sources: - NSWSS, Geoscience Australia

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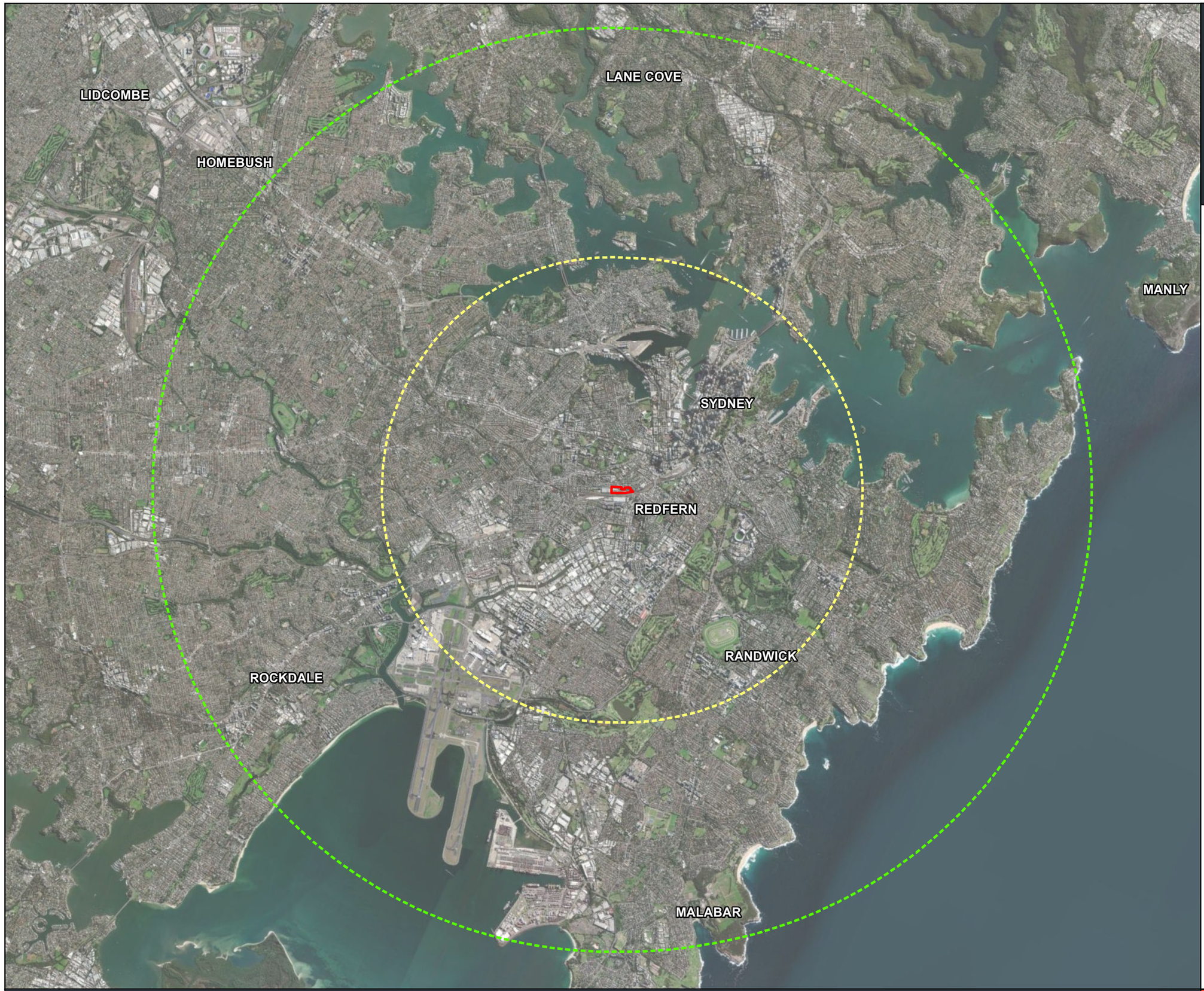

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Figure 5
Study Area

Study Area - Paint Shop Sub-Precinct

Buffer Radius

5km Radius

10km

0 1.5 3 Kilometers

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:80,000 Date: 26/10/2021

Data sources: - NSWSS, Geoscience Australia

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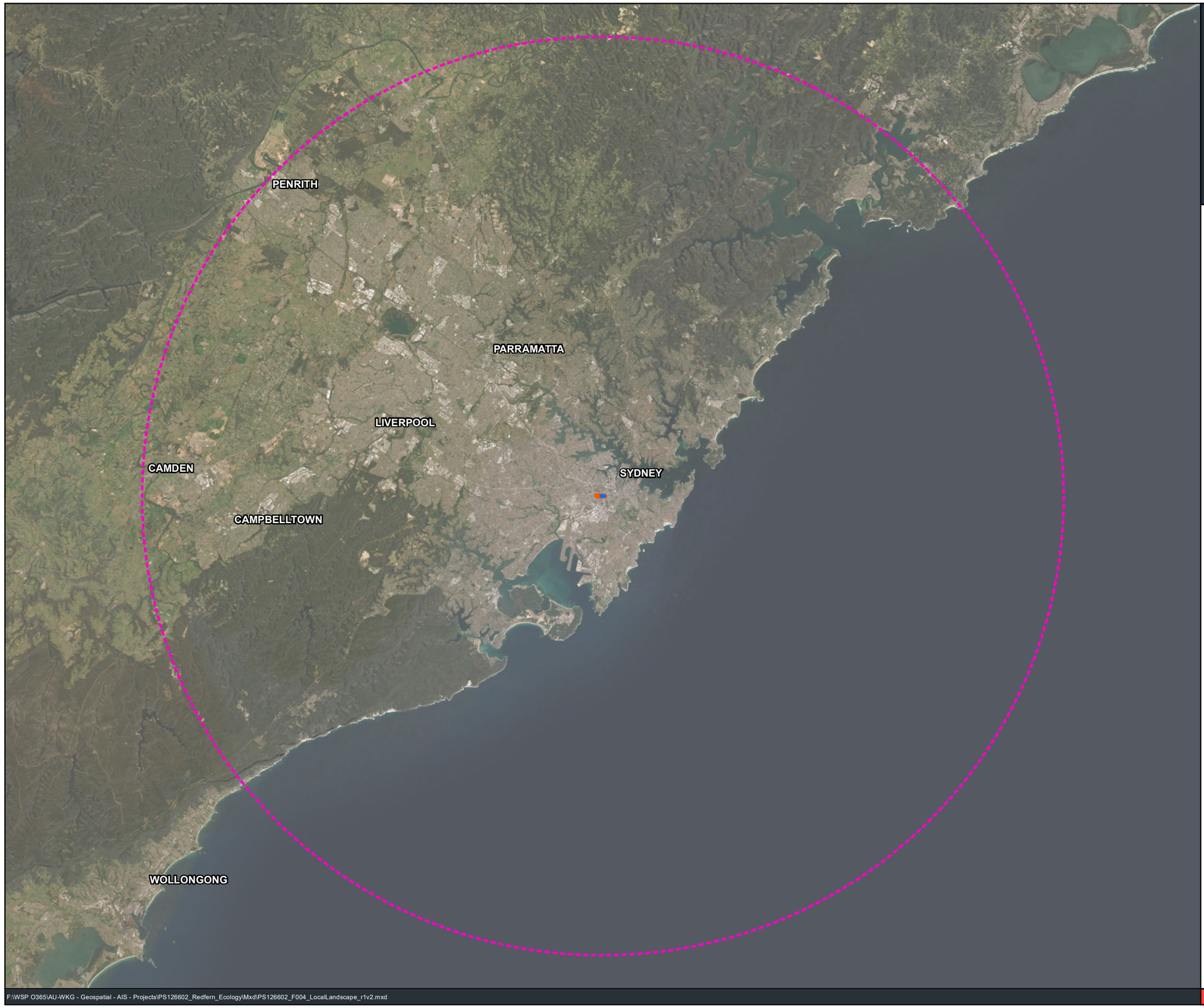

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Figure 5
Study Area

- Study Area - Paint Shop Sub-Precinct
- Redfern Precinct
- 50km radius of the study area

0 7.5 15
Kilometers

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:400,000 Date: 26/10/2021

Data sources: - NSWSS, Geoscience Australia

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2.4 Background Research

A background review of existing information was undertaken to identify the existing environment of the proposal within a search area of a 10km and 5km radius from the project site (see Figure 2.2) around the centre of the site. The review focussed on database searches, relevant reports pertaining to the study area, property boundaries, and relevant GIS layers. The review was used to prepare a list of threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. The searches were also undertaken to identify if any Areas of Outstanding Biodiversity Value (AOBV) are present.

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the investigation area were obtained from a range of databases as detailed in Table 2.2 below.

Table 2.2 Database searches undertaken

DATABASE	SEARCH DATE	AREA SEARCHED	REFERENCE
Bionet Atlas of NSW Wildlife	1 October 2021	Proposal site + 10km buffer	(NSW Government 2020)
Protected Matters Search Tool	1 October 2021	Proposal site + 10km buffer	(Department of Environment and Energy 2020)
Atlas of Living Australia	1 October 2021	Proposal site + 10km buffer	(Atlas of Living Australia, 2021)
PlantNet Spatial Search	1 October 2021	5km radius of proposal area	(Royal Botanic Gardens 2020)
NSW Department of Primary Industries Critical Habitat register	1 October 2021	Local waterways	(NSW Department of Primary Industries 2020)
NSW Government Areas of Outstanding Biodiversity Value register	1 October 2021	Search of the register	(Office of Environment Energy and Science 2020)

Regional vegetation mapping projects including the Southeast NSW Native Vegetation Classification and Mapping – SCIVI (VIS_ID 2230) (State Government of NSW and Office of Environment and Heritage 2010), the Native Vegetation of the Sydney Metropolitan Area - Version 3 (VIS_ID 4489) (State Government of NSW and Office of Environment and Heritage 2016) were reviewed as part of this study and are referenced throughout the report where appropriate.

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the NSW Threatened Species Scientific Committee website. There were no preliminary or provisional listings of relevance to the proposal.

The annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act was reviewed. One vulnerable species is of relevance to the proposal- The Grey-headed Flying-fox (*Pteropus poliocephalus*). The Grey-headed Flying-fox was identified as having 10-30% of its estimated distribution impacted by the 2019/2020 bushfires and was provisionally listed in the priority list of species while further information is gathered (DoEE 2020). The provisional listing for this species also considered a significant heat stress event over summer 2019-2020 coinciding with these bushfires.

2.5 Field Survey

A field survey was undertaken within the study area on the 5th of October 2021 to ground-truth the results of the background research and habitat assessment. This field survey specifically sought to:

- Validate existing broad-scale vegetation mapping and align vegetation types recorded with corresponding Plant Community Types (PCTs)
- Determine the nature and condition of vegetation identified within the study area
- Identify opportunistic observations of animals and evidence of animal activity (e.g. feeding signs, scats and scratches)
- If required, undertake vegetation integrity surveys in accordance with the BAM to assess native vegetation, threatened ecological communities, vegetation integrity, and habitat suitability for threatened species.
- Undertake fauna habitat assessments to determine habitat characteristics
- Where appropriate, clearly mark (GPS co-ordinates using a hand-held GPS) threatened biodiversity identified or significant habitat features

2.5.1 Vegetation Surveys

Due to the characteristics of the proposal site, as a brownfield location, a comprehensive vegetation survey was not able to be completed in accordance with Chapter 5 of BAM 2020 (Department of Planning, Industry and Environment, 2020). A plot-based vegetation survey of the study area was not undertaken as there were no Plant Community Types (PCTs) present in the development site and hence vegetation zones could not be established. A vegetation integrity assessment was not able to be undertaken. The vegetation survey was limited to identification of trees in the proposal site. The vegetation was mapped to identify vegetation extent.

2.5.2 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken within the study area on the identified list of threatened flora and fauna species known or predicted to occur in the Cumberland IBRA subregion that have been recorded within a 10 km radius of the proposal site (refer Appendix A) and see Figure 2.2. This list was identified from databases and literature as well as past surveys. The likelihood of occurrence assessment compared the preferred habitat features for these species with the type and quality of the habitats identified in the study area. This habitat assessment was completed to assess the likelihood of the species being present in the study area (i.e. subject species). The criteria used in the likelihood of occurrence assessment are detailed in Table 2.3 below.

Table 2.3 Likelihood of occurrence classification and criteria

LIKELIHOOD	CRITERIA
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km radius) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations. However may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km radius). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

2.5.3 Fauna habitat assessments

Fauna habitat assessments were undertaken to assess the likelihood of threatened fauna species (those species known or predicted to occur within the locality from the literature and database review) occurring. Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources
- presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles
- presence of the ground cover vegetation, leaf litter, rock outcrops and fallen timber and potential to provide protection for ground-dwelling mammals, reptiles and amphibians
- presence of waterways (ephemeral or permanent) and water bodies
- evidence of fauna such as scats, owl white-wash, tracks, animal remains (e.g. roadkill), foraging activity (e.g. feeding scars, scratches and diggings.

The criteria were used to evaluate the condition of habitat values are summarised in Table 2.4.

Table 2.4 Fauna habitat condition

HABITAT CONDITION	DESCRIPTION
Good	— A full range of fauna habitat components for that habitat type are usually present (for example, old-growth trees, fallen timber, rocky outcropping, feeding and roosting resources). — Habitat linkages to other remnant ecosystems in the landscape are intact.
Moderate	— Some fauna habitat components for that habitat type are missing or greatly reduced (for example, old-growth trees, rocky outcropping and fallen timber). — Although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
Poor	— Many fauna habitat elements for that habitat type in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing), removal of rocks and fallen timber, and tree canopies are often highly fragmented. — Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

2.5.4 Threatened species targeted surveys

The field-based habitat assessment identified that there is only limited habitat within the proposal site for threatened flora or fauna species. For this reason, targeted threatened species surveys were not undertaken for preparation of this Biodiversity Assessment Report.

2.6 Summary of survey effort and limitations

The single day vegetation field survey was able to provide adequate spatial coverage and survey effort for the entire study area. This was achievable in the timeframe given the small size of the study area. Detailed floristic survey of vegetation was not able to be undertaken as no native vegetation that could be assigned to a PCT was present on the development site. The conclusions of this report are based upon available data and limited field survey and are indicative of the environmental condition of the study area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species.

2.7 Considerations

Along with the results of the ecology survey, the following reports were reviewed to respond to the Considerations identified in Section 1, Table 1.1:

- Redfern North Eveleigh Paint Shop Sub-precinct Consultant briefing information (emailed from Project Team).
- Redfern North Eveleigh Paint Shop Sub-Precinct - Consultant briefing (1 March 2022 -Document s12470) (Bates Smart Turf 2022)
- Stage 2 Revised Masterplan – RNE Urban Design Report (Bates Smart 2022), particularly Section 9 – Urban Design Framework and 7.0 Urban Design Principles
- CoS Urban Ecology Strategic Action Plan (CoS 2014b)
- CoS Greening Sydney Strategy (CoS 2021)
- CoS Urban Forest Strategy (CoS 2013)

- CoS Green Roofs and Walls Policy (CoS 2014a)
- CoS Green Roofs and Walls Design Guide (CoS 2020)
- CoS Liveable Green Network Strategy and Master plan Report (CoS 2011)
- North Eveleigh Concept Plan 2008 (Urbis 2008)
- The Redfern North Eveleigh Strategic Vision - March 2021 (TfNSW 2021)
- Connecting with Country – Urban Design Initiatives (SMART 2021)
- Arterra North Eveleigh Precinct – Paint Shop Sub-precinct Preliminary Assessment (Arterra 2019, 2022)
- Redfern North Eveleigh Precinct Renewal Project – Connection with Country Framework (Balarinji 2021).

2.8 Consultation Process

In addition to attending the Redfern North Eveleigh Precinct Consultation with CoS on the 5th October 2021, the WSP Ecology personnel, Rodney van der Ree and Briony Mitchell, attended ecology-specific consultations with CoS and Ethos Urban. The CoS meeting with James MacNamara occurred on the 11th October 2021 and focussed on the urban ecology aspirations of the CoS. Consultation with Ethos Urban occurred on the 18th October 2021 and focused on the Planning Scheme Amendment process. The outcomes of these discussions have been factored into the delivery of this study.

The Redfern North Eveleigh Precinct Consultation with CoS 05.10.2021 comments summary document was also utilised to form the outcomes of the urban biodiversity recommendations (Section 9).

3 Existing Environment

3.1 Native Vegetation Communities

The proposal site has been comprehensively modified from its original state with only east of Gibbons Street providing some insight to local native vegetation communities. The natural vegetation has all been cleared and no remnant vegetation was observed within the study area (Photo 3.1).

There is some native vegetation (according to the definition of native vegetation provided in the LLS Act) that has been planted in the proposal site. However, this native vegetation is not naturally occurring and cannot be assigned to a Plant Community Type (PCT) as identified in the DPIE BioNet Vegetation Classification. As such, the vegetation cannot be allocated to vegetation zones. The habitat types in the proposal site and study area are best described as miscellaneous ecosystems as identified by the DPIE, specifically: Highly disturbed areas with no or limited native vegetation. The miscellaneous ecosystems spatial layer formed by DPIE can be viewed in Figure 3.1.

Photo 3.1 Representation of the modified nature of the proposal site.

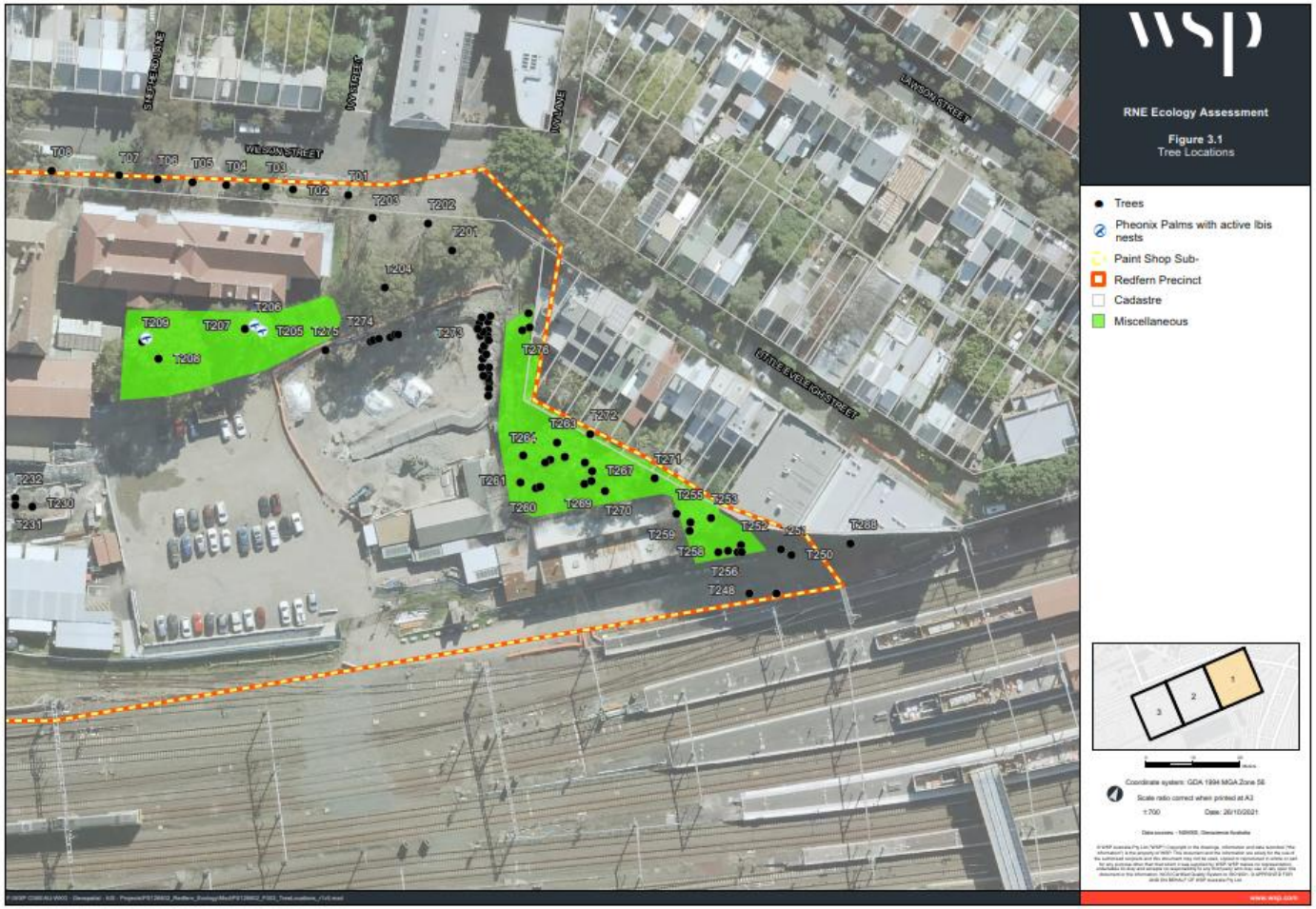

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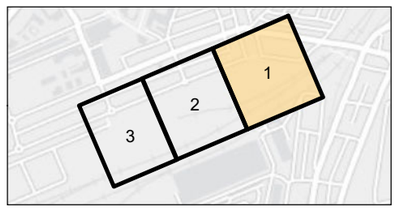
Figure 3.1 Results of the Ecology Assessment within the study area. Areas of the DPIE 'Miscellaneous ecosystems' was specifically classified as 'Highly disturbed areas with no or limited native vegetation.'

RNE Ecology Assessment

Figure 3.1
Tree Locations

- Trees
- Pheonix Palms with active Ibis nests
- Paint Shop Sub-
- Redfern Precinct
- Cadastre
- Miscellaneous



0 10 20
Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:700 Date: 26/10/2021

Data sources: - NSWSS, Geoscience Australia

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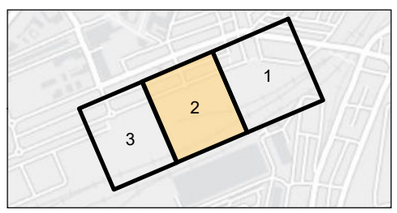
RNE Ecology Assessment

Figure 3.2
Tree Locations

- Trees
- Pheonix Palms with active Ibis nests
- Paint Shop Sub-
- Redfern Precinct
- Cadastre
- Miscellaneous



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Coordinate system: GDA 1994 MGA Zone 56

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Data sources: - NSWSS, Geoscience Australia

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CODRINGTON STREET

WILSON STREET

T47 T46 T45 T44 T43 T42 T41 T40 T39 T38 T37 T36 T35 T34 T33 T237 T236 T238 T239

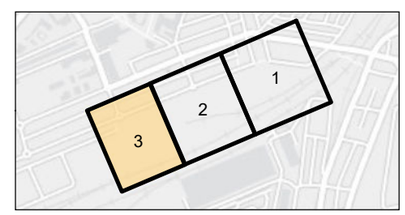
T284

T287

RNE Ecology Assessment

Figure 3.3
Tree Locations

- Trees
- Pheonix Palms with active Ibis nests
- Paint Shop Sub-
- Redfern Precinct
- Cadastre
- Miscellaneous



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Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:700 Date: 26/10/2021

Data sources: - NSWSS, Geoscience Australia

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Photo 3.2 Representation of the one-metre-wide green spaces where street trees have been planted within the study area.

3.4 Exotic Vegetation

The planted street trees were a mix of mostly native mature trees. However, some younger exotic trees have been recently planted. The exotic species include:

- *Celtis sinensis* (Chinese Hackberry)
- *Cinnamomum camphora* (Camphor Laurel)
- *Koelreuteria paniculata* (Golden Rain Tree)
- *Melia azedarach* (White Cedar)
- *Phoenix canariensis* (Canary Island Date Palm)
- *Platanus* x *acerifolia* (London Plane)
- *Schinus areira* (Peppercorn Tree).

Throughout the study area small green spaces were prevalent including areas of a mix of native and non-native planted species (Photo 3.3). However, the majority of these spaces were dominated by common weed species such as:

- *Ageratina adenophora* (Crofton Weed)
- *Andropogon virginicus* (Whisky Grass)
- *Asparagus aethiopicus* (Asparagus Fern)
- *Ligustrum lucidum* (large-leaved Privet)
- *Ligustrum sinense* (Small-leaved Privet)
- *Nephrolepis cordifolia* (Fishbone Fern)
- *Parietaria judaica* (Asthma Weed).

Photo 3.3 Example of one of the planted green spaces within the study area.

3.5 Threatened Ecological Communities

There are no threatened ecological communities located in or directly adjacent to the study area.

3.5.1 Ecosystem credit species

Ecosystem credit species are those threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection. Ecosystem credit threatened species must be assessed in conjunction with information about site context of the development site (Section 4.3 and Subsection 5.3.2 of the BAM), PCTs and vegetation integrity attributes (Chapter 5 of the BAM), and data from the Threatened Biodiversity Data Collection (Section 6.1 of the BAM).

During the assessment of biodiversity values as required by Chapter 5 of the BAM the proposal site was found to contain some planted native vegetation. However, this native vegetation is not naturally occurring and cannot be assigned to a PCT. As a result, if the BAM were applied to the assessment there would be no ecosystem credit species predicted to occur on the development site since there is no suitable habitat that can be used as a habitat surrogate. Ecosystem credit species have not been considered any further as there are no PCTs present on the proposal site and ecosystem credits could not be created.

There are two fauna ecosystem credit species that may use the few planted trees on the proposal site on occasion. Of these, the Swift Parrot (*Lathamus discolor*) may on rare occasion visit the trees to forage or perch. The Grey-headed Flying-fox (*Pteropus poliocephalus*) is likely to forage in the planted trees on a more regular basis given that the species is resident in the Sydney area.

Although located within a 50 km radius of several nationally important Grey-headed Flying-fox camps, the few planted street trees within the proposal site do not meet the criteria for foraging habitat critical to the survival of the Grey-headed Flying-fox outlined in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW, 2009) because the streets trees are not:

- productive during winter and spring when food bottlenecks have been identified

- known to support populations of > 30 000 individuals within an area of 50 km radius
- productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
- productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)
- known to support a continuously occupied camp.

Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of a significant impact on threatened species, populations or ecological communities listed under the BC Act. Tests of significance have been undertaken in accordance with the guidelines provided in the Threatened Species Test of Significance Guidelines (Office of Environment and Heritage 2018) which outlines a set of criteria to assist applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the 5-part test. The detailed assessments of significance are provided in Appendix B.

3.6 Groundwater Dependent Ecosystems

There are no groundwater dependent ecosystems located in or directly adjacent to the proposal site.

3.7 Critical habitat

No Critical habitat listed under the BC Act, EPBC Act or FM Act was identified within the proposal area.

3.8 Fauna habitat

Although large mature trees exist along the perimeter of the study area, no significant hollow bearing trees were observed during survey. The potential of other fauna habitat is considered minor due to the poor habitat quality within the study area and lack of mid-storey or ground cover habitat along the street edge.

Several large Phoenix Palms were observed to contain nests of the Australian White Ibis (*Threskiornis molucca*). These trees are T206, T205 and T209 as identified in the Arterra Existing Trees and Site Assessment Report (Arterra 2019). The location of the nests can be viewed in Figure 3.1.

Some abandoned buildings could provide habitat for common microbat species such as Gould's Wattled Bat (*Chalinolobus gouldii*) that utilise buildings as well as tree hollows for habitat.

3.9 Threatened Species

No threatened species were recorded during the site visit and desktop assessments have indicated a low likelihood of occurrence of any threatened flora and fauna species known to exist in the locality (10 kilometres) to potentially occur on site (aside from the Grey-headed Flying-fox and Swift Parrot).

3.9.1 Species credit species

If the BAM was applied to the proposal, species credit species would be assessed in conjunction with information collected about the site context of the subject land (Section 4.3 of the BAM), on PCTs and vegetation integrity attributes in (Section 5 of the BAM), and data obtained from the Threatened Biodiversity Data Collection (Section 6.1 of the BAM).

The proposal site was found to contain some planted native vegetation. However, this native vegetation is not naturally occurring and cannot be assigned to a PCT. The habitat types in the development site and study area are best described as

miscellaneous ecosystems as identified by the OEH, specifically referred to as "Highly disturbed areas with no or limited native vegetation". As there are no PCTs on the development site the BAM calculator would not return a list of credit species for assessment.

3.10 Wildlife Connectivity Corridors

There are no areas of significant vegetation surrounding the study area or presently providing connectivity from the study area to the wider landscape. The railway corridor is identified as a potential habitat linkage as outlined in the City's Urban Ecology Strategic Action Plan (CoS 2014b), although extensive fauna habitat is not present within the rail corridor currently. The existing rail ballast could potentially provide basking or sheltering habitat for native reptiles, such as Eastern Blue-tongue Lizard (*Tiliqua scincoides*). However, the trees growing in the urban matrix provide landscape connectivity opportunities for some species of birds and bats.

No other areas suitable of connectivity plantings were identified across the study area. Wildlife corridor opportunities are discussed further in Section 9.

3.11 State Environmental Planning Policy (Coastal Management) 2018

The proposal site does not occur within the mapped areas of 'Coastal Wetlands' or 'Proximity areas for Coastal Wetlands' and as such, the Coastal SEPP does not apply.

3.12 Matters of National Environmental Significance

3.12.1 Threatened ecological communities

There are no threatened ecological communities located in or directly adjacent to, or considered likely to occur, on the proposal site.

3.12.2 Threatened species

No threatened species listed under the EPBC Act are known to use the habitats within the study area, however due to the presence of several planted *Myrtaceous* street trees, these may provide an occasional foraging resource for Grey-headed Flying Fox and Swift Parrot.

No threatened plant species listed under the EPBC Act are considered likely to occur in the proposal site. The habitats are highly disturbed and there are no natural habitats present.

3.12.3 Migratory species

Eighty listed migratory species were identified in the EPBC Act Protected Matters Search Tool as potentially occurring in the locality based on the distributional range of the species and modelled habitat. These migratory species, along with their preferred habitat requirements and an assessment of their likely presence in the study area are listed in Appendix A (some species such as whales, sharks, fish, wader birds, wetland birds, marine birds were omitted from the assessment due to a lack of marine or wetland habitat in the development footprint). Only the Fork-tailed Swift and White-throated Needletail are considered moderately likely to fly over the development site but would not use it as habitat.

While some migratory species of bird may possibly use the study area and locality, the development site would not be classed as an 'important habitat'. A nationally significant proportion of the population would not be supported by the development site, as the habitats are not large enough or of high enough quality. The proposal would not substantially

modify, destroy or isolate an area of important habitat for any migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds.

4 Recommendations to avoid and minimise

As there are no PCTs and no loss of vegetation composition, structure or function (as assessed according to the BAM), recommendations to avoid and minimise impacts are limited and are related to maintaining existing overall native fauna habitat value or reducing pest fauna species within the study area.

A general principle of environmental management is to, in order of preference:

- avoid environmental impacts
- minimise impacts
- mitigate impacts
- as a last resort, once the above options have been investigated, compensate for the residual impact (offset).

Specific measures to avoid or minimise impacts are commonly determined and refined at the detailed design phase of a project when impacts are known. However, as this project is at the concept design phase, specific mitigation measures are limited and should be updated once the detailed design and construction methods are determined for the Sub-precinct. Updated measures should be included in a flora and fauna management sub-plan of the construction environment management plan (CEMP). Examples of best practice management measures can be found in the Transport's *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (TfNSW, 2011).

Specific measures to avoid and minimise impacts within the study area include the following:

- Standard fauna salvage protocols for local wildlife during tree removals, such as for birds nesting within the planted mature trees.
- Standard fauna salvage protocols for building removal or building feature removal where applicable, for species such as Gould's Wattled Bat or Possums, that may utilise abandoned buildings.
- Further retention of *Myrtaceae* tree species, including native and non-native species, to support Flying-fox and Swift Parrot intermittently foraging through the study area.
- Further retention or valuation of trees that are classified as 'High' value for Swift Parrot foraging, such as Sugar Gum.

It is also recommended that all Australian White Ibis nests are removed prior to construction commencing. Tree T209, in which a nest was observed, has been identified as a high value tree and is currently proposed for retention to meet canopy greening cover objectives. Australian White Ibis are often considered a pest species as they carry disease, such as bacteria Salmonella infection *(salmonellosis),* but are protected under the NSW *National Parks and Wildlife Act 1974.* Nests should be removed regularly to reduce Ibis numbers and passive bird deterrent measures implemented for long-term exclusion from the site (Ecosure 2018; Ross & Legoe 2006). An Ibis Management Plan should be developed for the Precinct, and can follow many plans previously developed and implemented at nearby Councils (Ecosure 2018; Ross & Legoe 2006).

Appropriate permits to remove Ibis nests and for general fauna salvage should be obtained by a wildlife handler/ ecologist prior to salvage commencing.

Ultimately, with the proposed green cover objectives and plantings, the study area will have enhanced ecological value and create fauna habitat above what is currently present. Further options to increase ecological value and mitigate impacts are presented in Section 9.

5 Potential Impacts

As detailed in Section 4, PCTs are not present within the study area. As such, impacts to ecological values are limited and vegetation removal is restricted to planted vegetation, including street trees, only. Australian White Ibis nests are recommended to be removed because they are considered a pest species in this circumstance. The project is currently at the concept design phase, where finalisation of the Urban Design Framework is occurring. Consequently, the likely impacts cannot be fully quantified at this time. Potential general impacts of the project are detailed below, and should be updated at the detailed design phase.

5.1 Construction Impacts

5.1.1 Removal of native vegetation

There is some native vegetation (according to the definition of native vegetation provided in the LLS Act) that has been planted in the proposal site. However, this native vegetation is not naturally occurring and cannot be assigned to a PCT as identified in the DPIE BioNet Vegetation Classification. As such, no impact to native vegetation is considered as occurring.

5.1.2 Removal of threatened fauna habitat

The proposal will remove a number of planted *Myrtaceous* street trees potentially utilised by the Grey-headed Flying-fox and the Swift Parrot. All three designated High value trees and 91% of the Moderate value trees are proposed to be retained (Arterra 2019), which include *Myrtaceous* species. As the design progresses, a detailed Arboricultural Impact Assessment (AIA) will be undertaken and the number of planted trees to be removed will be confirmed.

5.1.3 Removal of threatened flora

No threatened flora species were recorded during the site visit and desktop assessments determined a low likelihood of any threatened flora existing within the study area. Therefore it is concluded that no impact to threatened flora is occurring.

5.1.4 Injury and mortality

Injury and mortality of fauna could occur during construction activities and during operation of the proposal. Injury and mortality of fauna may occur:

- during construction when vegetation is being cleared and other habitat (e.g. abandoned buildings) is being removed or modified/constructed.
- when machinery and plant is moved to, from and on site
- when buildings, building features, planter boxes or rubbish are removed from site
- during Australian White Ibis nest removal
- during removal or alteration of retaining walls.

5.2 Indirect Impacts

5.2.1 Wildlife connectivity and habitat fragmentation

The proposal site is located within a highly disturbed urban landscape where most habitats have been cleared. However, planted urban vegetation, such as the planted street trees, does provide some habitat and plays a role in facilitating the movement of threatened species across the landscape, as stepping-stone elements.

Functional connectivity exists for highly mobile fauna species such as birds and bats that use the airspace above the proposal site to move between habitats and the planted vegetation is likely to be used as a foraging or perching resource as part of daily movements. In terms of threatened species, a very small portion of the Grey-headed Flying-fox population could potentially use the planted *Myrtaceous* street trees. It is somewhat possible the Swift Parrot may move through the area and forage on the planted *Myrtaceous* street trees although this is likely to be rare.

The proposal is considered highly unlikely to have a detrimental effect on fauna habitat connectivity. The threatened species that may use the development site are capable flyers, able to cover large distances between higher quality habitat patches. The habitats in the development site are not important or unique in the landscape and the proposal will have little effect on the current dispersal and movement of species through the locality.

An Assessment of Significance for both species is provided in Appendix C.

5.2.2 Edge effects on adjacent native vegetation and habitat

Ecological 'edge effects' are created when habitat is removed or fragments created via artificial edges and is often linked to development. Flora and fauna on 'edges' can face increased ecological disturbance, as 'edges' can act as dispersal barriers or filters, impose mortality and give rise to novel interactions, especially in the case of invading species. The term 'edge effect' is a term used to describe the various consequences on plants and animals, which occur as a result of one type of habitat conjoining with another. Due to the highly fragmented nature of the proposal site, any vegetation removal will not create any further edge effects, as all surrounding vegetation is likely planted and already subject to edge effects.

5.2.3 Invasion and spread of weeds

[Note: TfNSW to advise if below reference to Biodiversity Guidelines (TfNSW, 2011) is applicable here]

Invasion and spread of pests would be minimised in accordance with an approved Construction Environment management Plan (CEMP). This would include industry standard mitigation measures such as those outlined in the TfNSW Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (TfNSW 2011)"

5.2.4 Invasion and spread of pests

[Note: TfNSW to advise if below reference to Biodiversity Guidelines (TfNSW, 2011) is applicable here]

Invasion and spread of pests would be minimised in accordance with an approved CEMP prior to construction. This would include industry standard mitigation measures such as those outlined in the TfNSW Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (TfNSW 2011).

5.3 Cumulative Impacts

[Note: TfNSW to supply detail for all proposed sub-precinct impacts]

At this stage impacts discussed relate to the Paint Shop Sub-precinct only, as WSP have not undertaken an ecological assessment of the other two sub-precincts that make-up the project; the Redfern North Eveleigh Precinct. The streetscape trees surrounding the perimeter of the Paint Shop Sub-precinct provide stepping-stones for more mobile urban fauna species (E.g. birds) to move throughout the local landscape to any nearby parkland reserves, such as Alexandria Park and Eveleigh Green. However, as the streetscape trees are planted, loss of these trees would not contribute to the overall cumulative impacts of the project to native vegetation and biodiversity. Additionally, as no native vegetation was determined to be present within the study area, the contribution of the Paint Shop Sub-precinct to the cumulative impacts of the project are considered negligible.

6 Assessments of Significance

The BC Act (Appendix B) and EPBC Act (Appendix C) Assessments of significance were undertaken for threatened species and ecological community with a moderate to high likelihood of occurrence or that have been recorded in the study area.

Assessments of significance were undertaken in accordance with the following published guidelines:

- Part 7 Division 1 Section 7.3 of the BC Act – assessment of significance for BC Act listed biodiversity (5-part test)
- Significant Impact Guidelines 1.1 – Matters of National Environmental Significance for EPBC Act listed biodiversity (Department of the Environment 2013).
- Referral guidelines for species listed under the EPBC Act (Department of the Environment and Energy 2017).

Assessments of significance were undertaken for the Grey-headed Flying-fox and the Swift Parrot as potential foraging habitat is present in the study area. As both species are highly mobile nectivores and neither would be using the proposal as breeding or roosting habitat, the BC assessment was conducted together for both species (Appendix B). It is considered the proposal is unlikely to significantly affect either of these species.

A referral to the Commonwealth Minster for the Environment is not required for potential impacts to biodiversity.

7 Additional Considerations

In addition to the considerations presented in Table 1.1 that are addressed throughout this report, the CoS Urban Ecology Strategic Action Plan and the Connecting with Country Framework for the project influence the urban biodiversity recommendations presented in Section 9. Relevant issues to this assessment are discussed below.

7.1 City of Sydney Urban Ecology Strategic Action Plan

The CoS Urban Ecology Strategic Action Plan identifies important flora communities that occur across the municipality, as well as priority fauna species and priority sites to focus urban biodiversity enhancements (TfNSW 2021). Rail corridors have also been identified as 'supporting sites' in addition to the priority sites within the CoS Action Plan. Rail corridors throughout the CoS feature native grasses, planted vegetation, weed infestations, ballast rock and ground-level debris that may provide suitable habitat for a range of fauna species. However, the rail corridor adjacent to the study area doesn't contain native vegetation or other important habitats. The potential of the railway as a habitat corridor has been identified as a Consideration for this assessment. The CoS Liveable Green Network Strategy also identifies a connected cycling pathway and street network that are a potential habitat corridor within the municipality running through or nearby the study area. This includes the 'Harbour to Bay' path and a 'Main Green Corridor' path (CoS 2011).

Measures to enhance the rail corridor adjacent to the study area are provided in Section 9.

7.2 Connection to Country

Relevant Principles and Design Applicability Statements of Commitment from the Precinct's Connecting with Country (CwC) Framework to the Paint Shop Sub-precinct Ecology Assessment include (Balarinji 2021; SMART 2021);

- Statement of Commitment 1: We will respect the rights of the Aboriginal peoples to Indigenous cultural intellectual property, and we will support the right of the Country to be cared for.
- Statement of Commitment 2: We will prioritise Aboriginal people's relationship to Country and their cultural protocols, through education and enterprise by and for Aboriginal people.
- Statement of Commitment 3: We will prioritise financial and economic benefits to the Country where we are working, and by extension to the Traditional Custodians of that Country.
- Statement of Commitment 4: We will share tangible and intangible benefits with the Country where we are working, and by extension the Traditional Custodians of that Country, including current and future generations.
- Statement of Commitment 7: We will support Aboriginal people to continue their practices of managing land, water, and air through their ongoing reciprocal relationships with Country. We will create opportunities for traditional first cultures to flourish.

The applicability of these Statements of Commitment and link to CwC Urban Design Initiative themes are present in Table 7.1. Overall, when choosing specific measures to meet CwC initiatives, such as flora species to plant at a meeting place, consideration should be given to the outcome on the ecological value of the Precinct.

Table 7.1 Applicability of Connecting to Country Framework for the Precinct development.

STATEMENT OF COMMITMENT	APPLICABILITY TO ECOLOGY ASSESSMENT	URBAN DESIGN INITIATIVES - RELEVANT THEMES
1	The Ecology Team acknowledge the Gadigal as the Local Custodians of the Redfern North Eveleigh Precinct.	Custodianship
2	In relation to 'applicable item 1' – input will be provided through the Ecology Assessment on native flora and fauna present within the study area and provide recommendations on creating functional ecosystems/ connectivity.	Regenerating Country Replacing Landmarks
3	The Ecology Assessment will help to quantify environmental impacts and the Ecology Team can provide expert advice on environmental success measures.	Regenerating Country
4		
7	The Ecology Assessment, particularly Section 9, suggests opportunities to create CwC physical and interpretive spaces through biodiversity urban sensitive design.	A Meeting Place

8 Consultation Outcomes

8.1 City of Sydney

The CoS meeting with the Ecology Team (11th October 2021) was focussed on:

- The importance of considering design practices that may attract some of the eight priority fauna species identified in the Urban Ecology Strategic Action Plan, and
- The importance of the creation of the habitat 'stepping stones,' as opposed to continuous habitat corridors which are not feasible within the local landscape of the study area. CoS noted that the Eveleigh area has the potential to connect through to Sydney Park, a priority site of the Urban Ecology Strategic Action Plan.

The eight priority species or species groups, as listed within the Urban Ecology Strategic Action Plan, are:

- Green and Golden Bell Frog (*Litoria aurea)* and other frogs.
- Grey-headed Flying-fox.
- Powerful Owl (*Ninox strenua*).
- Long-nosed Bandicoot (*Perameles nasuta*).
- Microbats, such as Gould's Wattled Bat.
- Small birds.
- Freshwater wetland birds.
- Reptiles, such as the Eastern Blue-tongue.

9 Enhancing Urban Biodiversity

The primary ecological aims for the site are to enhance ecological values, provide opportunities for people to connect with nature and to support the overall design aims and objectives of the project (Figure 9.1). Given the highly modified nature of the study area, the ecology strategy intends to find a balance between these three potentially competing aims for the site. For this project, the concept of biodiversity creation and value will need to move away from some-what traditional thinking, such as the creation of reserves with locally indigenous flora species, and instead focus on singular elements, such as street trees, garden beds, pocket-parks and planter boxes, to create biodiversity value on a small-scale, which will then combine to create biodiversity across the Precinct as a whole. Actions to do so are presented below.

Consequently, the overarching objective of the proposed biodiversity enhancement actions are to balance these three competing aims through the creation of multi-functional green spaces, that maximise the urban greening objectives, biodiversity enhancement objectives and Connecting with Country (CwC) objectives of the entire Project. For example, when choosing a tree/shrub/flower to plant for a CwC initiative or to increase percentage green cover, also consider the potential value of that choice in creating or supporting biodiversity.

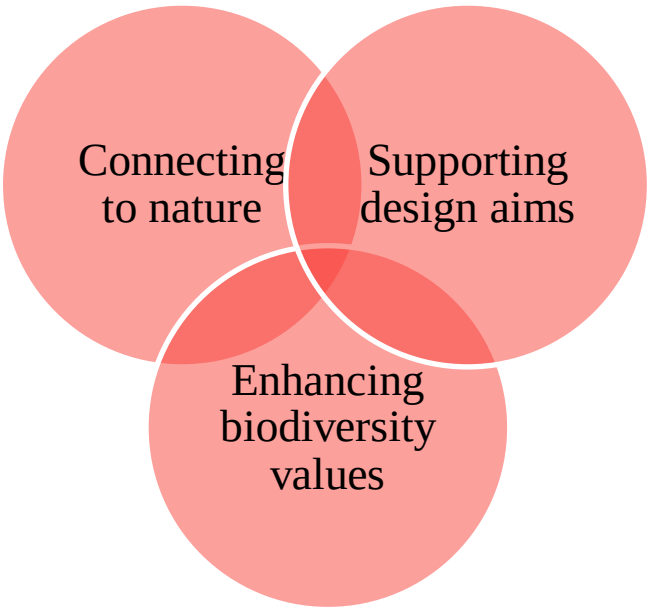

Figure 9.1 The concept of competing aims when creating biodiversity in an urban environment. The objective is to increase the degree of overlap between the three aims.

9.1 Biodiversity sensitive urban design

Cities and towns are important for supporting and sustaining biodiversity, with renaturing cities becoming a common objective for local governments (Barnett 2002; Connop et al. 2016; Mata et al. 2020; Owens & Wolch 2019). Urban green spaces that provide habitat for flora and fauna can include bushland reserves, cemeteries, golf courses, open parkland, as well as smaller areas, such as roadsides, streetscapes, planted gardens, backyards or singular trees (Salbitano 2016; Soanes et al. 2018). Novel habitats such as these, are known to support threatened native species within Australian cities (Soanes et al. 2020).

The potential threats to biodiversity in cities can be more prevalent than in natural areas (e.g. noise or light pollution) or impacts may occur through different pathways (e.g. attack by domestic pets, weeds from garden waste, collisions with buildings). As such, management actions must address unique challenges including human-wildlife conflict and multi-use or multi-function spaces (Mata et al. 2020; Owens & Wolch 2019; Parris, Kirsten M. et al. 2018; Soanes et al. 2020).

Many frameworks or design guidelines have been developed by researchers and practitioners to combat these unique challenges and integrate urban greening to provide better biodiversity outcomes (Avlonitis et al. 2012; Friedman 2021; Ikin et al. 2015; Li et al. 2005; Parris, Kirsten M. et al. 2018; Salbitano 2016; Soanes et al. 2018; UoL 2019; Yılmaz & Mumcu 2016).

Biodiversity Sensitive Urban Design (BSUD) or Low Impact Urban Design is an ecological framework arising from this research base that aims to help practitioners to create urban areas that deliver on-site benefit to native species and ecosystems, as well as people, by utilising novel urban spaces and innovative design (FAO 2016; Garrard G. E. 2017; Ignatieva, Stewart & Meurk 2008; Parris, Kirsten M. et al. 2018). BSUD aims to improve nature, improve liveability and involve stakeholders to create successful urban design scenarios (Garrard G. E. 2017; Parris, Kirsten M. et al. 2018).

The following five key principles of BSUD have been developed and are appropriate for this project (Garrard G. E. 2017; Ikin et al. 2015; Parris, Kirsten M. et al. 2018; UoL 2019; Yılmaz & Mumcu 2016):

1 Maintain and create species habitat

2 Facilitate species dispersal

3 Minimise anthropogenic disturbance

4 Promote ecological processes (multi-functional design)

5 Connecting people with nature.

The Framework presented below should also be considered alongside the CoS Greening Sydney Strategy actions and the Urban Ecology Strategic Action Plan (CoS 2014b).

The revised Masterplan has created further opportunity to support biodiversity, with a 30 % reduction in residential floorspace reinstated as open space and an increase in tree canopy (ca 25 %), total green cover (40 %) and permeable surface (19 %) to support Water Sensitive Urban Design (WSUD) (Bates Smart Turf 2022). The proposed large open space areas include:

- Public Square at 7,900 square metres (sqm)
- Eastern Park at 3,800 sqm.

9.2 Actions

The following principles of BSUD are detailed below to provide practical examples of implementation. These actions should be incorporated into proposed planning controls for the paint shop sub-precinct.

9.2.1 Maintain and create habitat to benefit wildlife

Providing opportunities for species habitat is the first action of BSUD. In urbanised landscapes, all natural areas, regardless of size or composition have existing and potentially enhanced values for wildlife and other biodiversity.

Maintaining or creating habitat can include:

- Protecting existing habitat and green space, through exclusion fencing or securing land tenure
- Restoring areas of low ecological value (revegetation)
- Adding habitat treatments, such as artificial nest boxes or logs
- Adding urban greening design, such as planter boxes, green roofs, walls or facades.

Examples to create and restore habitat are provided in Table 9.1.

Many species from different trophic levels are needed to create positively functioning and biodiverse spaces and ecosystems (Soliveres et al. 2016). For example, insects are important indicators of biodiversity and provide many

ecosystem functions, including acting as plant pollinators or being food for wildlife. As such, insects must firstly be attracted to urban spaces. The creation and optimisation of native habitat within urban open spaces should focus on improving broad scale biodiversity at each site.

Generally, the larger the habitat areas, the more likely they are to support a more diverse set of species. Whilst greening and "rewilding moments" are incorporated into the Masterplan at the larger open spaces (e.g. Public Square), the focus of these large open spaces is public amenity and vibrancy, including a central lawn area (Bates Smart 2022; Bates Smart Turf 2022). In these multi-use, large spaces care should be taken when considering the longevity of supporting biodiversity. Urban Design Principle 7 states that avoiding the "massing" of buildings as an important design feature. This principle can also be applied to public use of open space and gathering, where wildlife is likely disturbed by the residual impact of crowds, such as noise. To support biodiversity and diverse species, some quiet areas where public access is limited is required (discussed further in sections 9.2.3 and 9.2.5). Small spaces throughout the Precinct can offer this quiet space for wildlife.

Small spaces and single elements of habitat (e.g. a tree hollow, a flowering shrub, a thicket of native grasses, etc) can be extremely valuable and should be identified, protected and/or created. This concept is particularly relevant to the current project, where larger areas of remnant habitat are not present, and as such, cannot be protected and incorporated into the design and where larger open spaces are required for public amenity and gathering. Therefore, the project will need to focus on:

- Retention of both native and non-native planted trees and shrubs.
- Appropriate planting of existing green space, for example using the 1 m wide plots where street trees are planted (Photo 3.3)
- The addition of habitat treatments for priority fauna species.
- The addition of smaller-scale greening design elements, such as green walls or planter boxes. Planter boxes currently on site could be re-planted and used within the design framework (Photo 9.1).
- The inclusion of logs, rocks and rock piles, undulating grassed areas or small ponds should be incorporated in green space design (pocket parks), which can also add value as children's play areas.
- Maximising substrates that support or create biodiversity, particularly when including permeable surfaces for WSUD. This can include incorporating raingardens within gravelled open spaces that are to be used for WSUD (Figure 9.2).

A mosaic of habitat features should be utilised, which can be achieved by using different natural materials (nest boxes, areas of open soil, small areas of dense prickly vegetation, small water bodies etc). Small-scale treatments, such as planter boxes or insect hotels, can increase biodiversity in the urban space (Berthon et al. 2021; Cabanek, Zingoni de Baro & Newman 2020). Case studies have shown that creating 'Pocket Park' habitats, a planter on a windowsill, or modifying street scapes can have positive impacts on biodiversity.

To create biodiverse habitats in the urban space the following items should be considered:

- Habitat structure and diversity
- Habitat treatments
- Habitat connectivity (explored in Section 9.2.2).

For this project, garden space, including that for WSUD, should be maximised and include a diversity of plantings for pollinating insects and small birds. Choice of flora species to plant should focus on a diversity of flowering and fruiting species, rather than solely on the inclusion of locally indigenous species. The CoS Urban Ecology Strategic Action Plan flora list can be followed, although the final list and placement of plantings, even within planter boxes, should be verified by an expert.

Table 9.1 Opportunities to create biodiverse habitat in the study area.

TYPE	EXAMPLES
Novel spaces (re-retrofitting open spaces)	Green roofs, walls and facades (CoS 2014a, 2020). Converting pavement to plantings. Protecting non-native vegetation that serves an important ecological role, such as prickly weeds providing shelter to small birds, reptiles and small mammals. Rail corridor – revegetation and exclusion fencing, retention of ballast rock.
Restoring or creating vegetative habitat	Replanting garden beds. Green roofs, walls and facades. Creating and managing Pocket Parks within the Precinct. Residential balconies in the new buildings– for example planter boxes could be supplied to new residents or to existing residents nearby.
Habitat treatments	Water-sensitive urban design (WSUD) for habitat creation, such as raingardens. Create nesting opportunities, such as habitat structures (E.g. nest box) as there were no natural tree hollows observed within the study area. Logs, rocks and rock piles. Insect hotels. Planter boxes. Repurposing removed tree limbs trunks or hollows. Artificial hides or shelters for wildlife.
Habitat protection (Laws and regulations)	Tree Protection Zones. Fencing and gates to restrict access by people to certain habitat areas within the Precinct. Invasive or nuisance species management (E.g. Ibis). Designated walking tracks or shared use pathways. Signage.

Source: Developed from (Soanes et al. 2020).

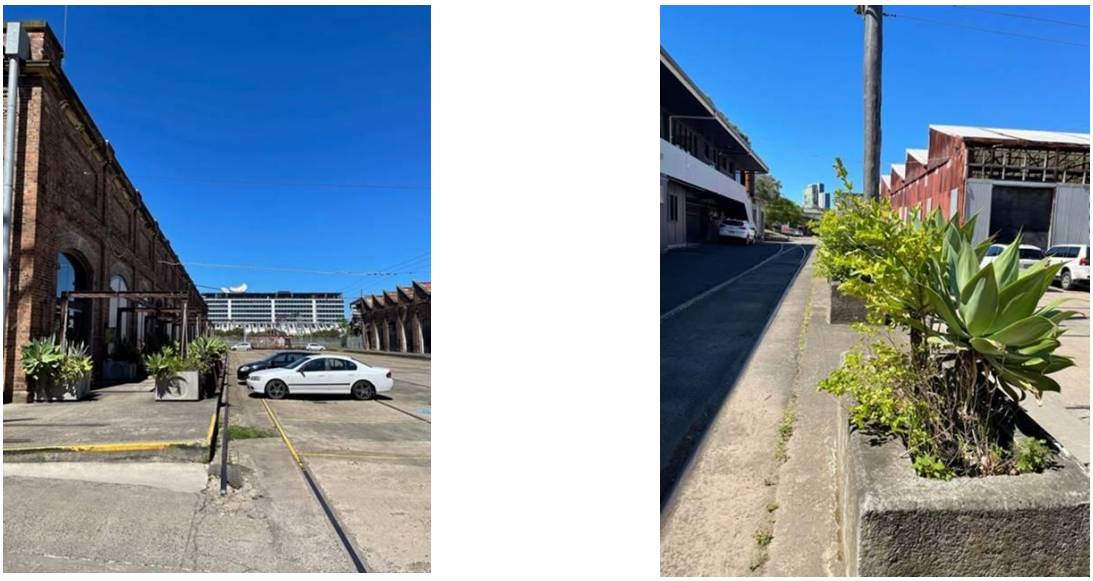

Photo 9.1 Planter boxes currently on site. These planters provide an example of small-scale options to create biodiversity for the project if they had been planted with appropriate flora species.

Figure 9.2 Gravel material used as for permeable surface areas should be maximised to balance biodiversity creation and water sensitive urban design, such as the use of raingardens and other small-scale habitat features.

Source: Bates Smart (Bates Smart Turf 2022) – image from consultant briefing.

Some useful resources for habitat creation include:

- Central Coast Council (2016), *Guideline for the Relocation of Large Tree Hollows*, <https://static1.squarespace.com/static/55b839c6e4b0a286c4c4a481/t/58a6654a414fb56f8ea9a0e5/1487299930479/Guideline-for-Relocation-of-Large-Tree-Hollows.pdf>.(Central Coast Council 2016)
- City of Sydney (2019), *Habitat Creation Guide*, City of Sydney, <https://www.cityofsydney.nsw.gov.au/guides/urban-habitat-creation-guide>.(City of Sydney 2019)

9.2.2 Facilitating species dispersal

This action aims to establish habitat connectivity corridors or pathways through public and private land throughout the local landscape. In the urban space, areas of connectivity can include continuous or near-continuous corridors of vegetation, stepping stones (backyards, street trees, habitat structures etc.), scattered trees or other types of vegetation and certain habitats within continuous patches of vegetation, such as gullies or watercourses. As habitat restoration is detailed above, this action particularly pertains to novel habitat connectivity options, such as wildlife crossing structures or stepping stones. Wildlife crossing connectivity structures can be utilised when natural habitat connectivity cannot be maintained, which is often the case within cities and towns.

Habitat structures are a potential option for connectivity habitat along the adjacent rail corridor and through to the wider local landscape where priority sites or areas of remnant habitat have been identified. As directed by CoS, the creation of 'stepping stones' from the use of habitat structures, rather than large tracks of linear habitat fragments, is likely to be more appropriate within the local landscape. These stepping stones should also include pocket plantings throughout the rail corridor and utilise ballast and other debris to avoid impacts to potentially residing reptile species.

When choosing habitat structures or locations for implementation consider the following aspects:

- Identify suitable areas where wildlife can flourish while managing potential wildlife hazards, disturbances, and wildlife-human interactions.
- Recognise the potential of habitat structures and features to support undesirable species (e.g., competing invasive species).
- Ensure wildlife structures are suitable for the target species if one is identified as part of the BSUD goals.
- Monitor and maintain habitat structures to assess use and ensure structures are in good condition.
- Consult an appropriately qualified environmental professional to verify design, placement, and other requirements.
- Consider existing and future climate conditions.

9.2.2.1 Habitat connectivity in the rail corridor

The above measures flow into Fauna Sensitive Design (FSD); the process of planning, designing, building, operating and managing a linear network (road, rail, waterway etc.) that has the least possible negative impact on wildlife. In practical terms, a linear network that is sensitive to fauna is one that:

- Facilitates the movement of wildlife across the linear infrastructure so that (i) wildlife can access resources they need on a daily, seasonal, and annual basis, including food, shelter, and mates; (ii) wildlife can avoid predators; (iii) animals can disperse from natal and other areas and establish new territories or join others; and (iv) that migratory species are able to undertake their seasonal or annual migrations without interruption.
- Avoids, minimises, and prevents the injury and mortality of wildlife due to collisions with vehicles, trains or other infrastructure, entrapment on the tracks or from other causes.
- Avoids and minimises the loss of habitat.

'Green' rail corridors are increasingly becoming a common feature in urban landscapes around the world. The rail corridor adjacent to the study area is currently void of native vegetation and provides limited fauna habitat opportunities,

other than reptiles amongst the ballast rock and debris. Landscaping and revegetating within the corridor is possible in the form of stepping stones; pockets of plantings, as the free green space (dirt) between rail lines is limited. It is noted that the rail corridor throughout the wider local landscape (i.e. 5km, 10km or 50km buffers) was not inspected. It is possible that there are more opportunities to enhance the biodiversity outcomes elsewhere along the rail corridor, especially on the verge of the railway where longer, wider, and more diverse plantings are feasible. Line of sight and other safety elements should be considered in the planning of planting locations. Any planting within the rail corridor would need to meet operational standards.

In general, landscaping and revegetation plans for stepping-stones in the rail corridor should also focus on achieving small-scale biodiversity enhancements through diverse plantings of primarily understorey species. Important considerations will include maintenance requirements, human safety and the potential for wildlife-train collisions (WTC). For instance:

- Have any unintended consequences for wildlife been considered, such as the provision of habitat too close to the railway that may increase the risk of WTC?
- Have any unintended consequences for infrastructure been considered, such as the planting of tall trees adjacent to electrified railways?

Pocket plantings within the rail corridor should follow the advice provided in Section 9.2.1.

Additionally, some species of microbat and birds (e.g. swallows and martins) will roost/nest and breed in railway infrastructure, such as concrete box and pipe culverts, bridges (timber and concrete) and buildings. Roost sites for microbats can include lift-holes in culverts, expansion joints, girders and parapets on concrete bridges, and timber decking, split stringers, secondary stringers, cross girders, truss, and support beams on timber bridges. As such, there is an opportunity throughout the local landscape, where this infrastructure is present, to, again, create stepping stones of habitat if not already present in the rail corridor. The intentional inclusion of roosting and nesting opportunities for wildlife should be considered throughout the project, but especially in areas where natural roosting opportunities are limited and buildings and building features will be removed within the Paint Shop Sub-precinct.

9.2.3 Mitigating anthropogenic disturbance

BSUD must incorporate tools to combat the heightened risk of anthropogenic threats to wildlife in the urban space, particularly when considering the proposed activities and use of the Sub-precinct. Anthropogenic impacts will include increased noise, vibration and lighting during construction. This is also expected during the operational phase with night lighting and human use of the space at night. Ultimately, it is predicted that heat will be reduced, given the current extent of concrete within the study area. Examples of actions to moderate anthropogenic threats are provided in Table 9.2, with noise and lighting detailed further below.

Table 9.2 Opportunities to reduce anthropogenic impacts to urban nature.

TYPE	EXAMPLES
Design features	Raised walkways to avoid trampling of sensitive plantings. Transparent surfaces to allow light to permeate vegetation. Shade cloth to reduce temperature and provide shade. Water Sensitive Urban Design. Choice of lighting features or design of buildings to reduce light emission, particularly at night. Bird deterrent strips on windows, walls and noise walls to prevent roosting. Sound barriers and noise walls (Sheppard 2011). Earthen berms.

Physical modifications to structures	Modifying light structures (height, placement, shielding etc) to reduce spill over from artificial light at night. Flags and markers to reduce collision of birds with windows. Reduce impervious surfaces to improve soil conditions. Bird perching and collision deterrents for buildings, electrified railway and other structures to reduce perching and nesting where not preferred (i.e. near cafes) (T-PVS / Inf 2003). Bird deterrent strips on windows, walls and any noise walls to prevent collision.

Noise

Noise at the post-operational phase of the project may prevent some fauna species, such as small birds, from occupying the Precinct, and as such, opportunity for biodiversity enhancement may be reduced. Species that are exposed to high levels of anthropogenic noise have experienced a range of responses, including reduced breeding success (Halfwerk et al. 2011; Reijnen & Foppen 1994) and lower survival rates, potentially such that otherwise suitable habitat is no longer occupied (Slabbekoorn & Ripmeester 2008). There is also an increasing body of evidence demonstrating a variety of responses to anthropogenic noise in frogs, birds and other species that rely on acoustic signals, including hearing loss (Brumm 2004; Hoskin & Goosem 2010; Parris, Kirsten M & Schneider 2008; Slabbekoorn & Ripmeester 2008). However, guidelines on how to reduce noise pollution for wildlife are lacking.

The following noise threshold levels provided in Dooling & Popper (2007) are recommended:

- Traffic noise should be kept below 60 dB(A) to prevent masking.
- Limits of 93–110 dB(A) for continuous traffic noise to prevent temporary hearing loss in birds.
- Noise pulses to not exceed 125 dB(A) to prevent permanent damage to hearing.

The Noise and Vibration Assessment found that attended measurements were representative of an urban build-up area in close proximity to transport corridors, i.e. rail and road (Aecom 2021a). Baseline existing background noise was found to be between 37 and 65 dB(A) during the day and 33 and 61 37 and 65 dB(A) at night (Aecom 2021a). This currently falls below the required continuous noise limits, as detailed above. As such, for fauna one-off noise pulses are likely to be the main source of stress if residing within the sub-precinct. Train pass-by noise measurements ranged from 68 to 89 dB(a). Again, this measurement falls below the recommended upper limit. However, measures to reduce noise emittance during construction should be included in a Construction Environmental Management Plan (CEMP).

Given the existing environmental constraints of the sub-precinct (i.e. located within an urban environment, and surrounded by existing roads and a railway line), there is limited capability to reduce noise. As such, strategies to reduce noise will need to focus on the placement of habitat itself within the sub-precinct. Areas where noise will be lowest or where night activities are not likely to occur should be preferred for habitat placement. Some strategies to mitigate the ecological impacts of noise can be implemented at the source or to reduce the severity of noise during or after emission, including (The Centre for Urban Design 2016):

- Planting of dense vegetation along streets surrounding the precinct.
- Noise walls, that could also be used as green walls.
- Building sound-proofing.
- Smaller soil berms, that can be incorporated into green space/pocket park design.

The proposed speed limits, including for shared streets at 10km/hour, within the Sub-precinct will also help to reduce noise levels within the vicinity of proposed habitat features (SCT 2021).

A guideline on noise wall design is provided below:

- The Centre for Urban Design, RaMS (2016), *Noise wall design guidelines - design guidelines to improve the appearance of noise walls in NSW*, <https://roads-waterways.transport.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/noise-wall-design-guideline.pdf>.

Lighting

Artificial light that alters the natural patterns of light and dark in ecosystems is referred to as 'ecological light pollution' (Longcore & Rich 2004). Types of ecological light pollution include chronic or periodically increased illumination, unexpected changes in illumination, and direct glare (Longcore & Rich 2004). For the project, excessive light may prevent species from utilising the site, such as the CoS priority species Grey-headed Flying-fox.

Artificial light affects species in different ways, but the main responses are:

- Disorientation – Artificial light sources may disorient night flying species including birds and bats, as well as other species such as turtles (Gleeson & Gleeson 2012). Conversely, artificial lighting may increase orientation, providing a benefit to particular species.
- Attraction – Predator species such as Magpies and Kookaburras are attracted to the lights due to the increased insect activity (Patriarca 2010), as are some species of insectivorous bats. Wading birds have also shown increased foraging success under artificial lighting (Santos et al. 2010), however, this may lead to increased predation.
- Avoidance – Some species may avoid well-lit areas due to an increased risk of predation (Longcore & Rich 2004), however, it can be difficult to separate any avoidance behaviour shown by fauna as being the result of the lighting compared to noise or a physical barrier (Gleeson & Gleeson 2012).

The above responses may affect foraging, reproduction, communication, and other critical behaviours (Longcore & Rich 2004). One of the most notable implications of light pollution is alteration of interspecific interactions (e.g. predator-prey and competitive interactions) (Longcore & Rich 2004). In animals, visible light ranges from 300 nm to greater than 700 nm, depending on the species (DoEE 2020).

The current light pollution parameters are detailed within the Pollution Assessment, with potential impacts discussed (Aecom 2021b). Currently, the sub-precinct is dark in nature with minimal existing lighting due to the current lack of use and public access to the site (Aecom 2021b). The addition of buildings for housing and commercial use will increase light pollution for any fauna moving into the site post-construction. The Paint Shop sub-precinct will be required to limit spill light in accordance with the light technical parameters and calculation requirements outlined in AS4282 'Control of the obtrusive effects of outdoor lighting' (Aecom 2021b). Additional design measures to reduce obtrusive and projected light onto habitat features for fauna should be considered.

In the urban space, well-designed lighting should consider energy efficiency, human lighting needs, location and placement, type, amount required and timing of light needed (Surrey 2021). Design should start with natural darkness as the preferred outcome, and then move to employing design measures to reduce the impact of necessary lighting levels on wildlife (DoEE 2020; Ironbark Sustainability 2018).

Design features or physical modifications that should be considered for this project include:

- Adaptive controls (sensors, remotely managed timers, colour, motion sensors, dimmers)
- Alteration to the amount of light produced (lumen), with low glare measures
- Filtered out blue, violet and ultraviolet wavelengths (between 400-500 nm)
- Light only the intended object or area. Keep lights close to the ground, directed to where light is needed and shielded (DoEE 2020)
- Turn off or mask interior lights visible to the outside at night
- Implement a municipal "Lights Out" program that applies throughout the year
- Use non-reflective, dark-coloured surfaces to reduce amount of reflected light

- Consider vegetation screens around higher density lighting areas for fauna to move through
- Dim lights in public areas when people are absent, or adjust lighting for particular species known to occur in the area.

Guides on designing for noise remediation area provided below:

- DoEE 2020, *National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds*, Commonwealth of Australia, Department of the Environment and Energy, Canberra, <https://www.environment.gov.au/system/files/resources/2eb379de-931b-4547-8bcc-f96c73065f54/files/national-light-pollution-guidelines-wildlife.pdf>.
- Ironbark Sustainability 2018, *Moreton Bay Regional Council Technical Specifications for Wildlife Sensitive Outdoor Lighting* Moreton Bay Regional Council Collingwood.

9.2.4 Promote ecological processes

The importance of maintaining ecological processes in the urban space is also highlighted in BSUD. BSUD should facilitate natural processes and cycles, considering the natural management requirements of target species and habitats. This is to ensure adequate resources are provided to native species within the urban landscape. This aspect is somewhat addressed with the maintenance and creation of habitat, but also points to the need for multi-functional design of urban green space; a component of which is water sensitive urban design. Opportunities to utilise groundwater and surface water run-off is being considered by the project separately and being incorporated into water sensitive urban design measures (Aecom 2021c). Current flooding and stormwater conditions are provided in the Water Quality, Flooding and Stormwater Assessment Report (Aecom 2021c).

Ecological processes to consider whilst planning for BSUD include:

- Ecological burning regimes (E.g. grassland habitats), which could be applicable to the Connecting with Country Framework, but challenging for the project in an urban environment.
- Pollination.
- Retention of nutrient cycling (keep organic litter and reduce litter).
- Flooding on site and inclusion of this into WSUD.

Multiple WSUD Guidelines and design specifications for creating aquatic habitat are available with some provide below:

- Department of Environment and Conservation NSW: Managing Urban Stormwater – Harvesting and Reuse Guidelines
- CSIRO 2006, *Urban Stormwater: Best Practice Environmental Management Guidelines. Chapter 5: Water Sensitive Urban Design*, CSIRO PUBLISHING, Melbourne, <https://www.publish.csiro.au/ebook/chapter/SA0601047>.
- MS (2017), *Water sensitive urban design guideline: Applying water sensitive urban design principles to NSW transport projects*, NSW Government, <https://roads-waterways.transport.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/water-sensitive-urban-design-guideline.pdf>.
- Sydney Water (2018) Water Sensitive Urban Design. <https://www.sydneywater.com.au/content/dam/sydneywater/documents/water-sensitive-urban-design.pdf>.

9.2.5 Connecting people with nature

The positive social benefits of green space and nature in cities has long been documented. BSUD should aim to facilitate public engagement and local stewardship of biodiversity.

The project should consider and include ways that encourage people to connect with nature in some way, including:

- Design and use of green spaces for events and social gatherings where suitable, or simply the encouragement of walking through any green space areas. For example, design footpaths to move through green spaces.
- Points of connection to nature, including signage, seating, recordings to encourage engagement.
- Provision of active transports links for multiple users (shared user pathways (Melbourne Water 2009).
- Targeted habitat revegetation programs or education evenings (E.g. for bats) that include education and interpretation opportunities for users of the space.
- Explore the ways in which cultural and practical 'Caring for Country' principles can assist in connecting people with nature.

Despite the need to connect people with nature, some habitat areas should be recommended to have reduced visitation by people to provide some 'core' habitat value areas. Rather than fencing, conservation buffers around sensitive areas could be used, which can be helpful beside footpaths or shared user pathways. Options to promote connection to nature are provided in Table 9.3.

Table 9.3 Options to promote human-nature interaction.

TYPE	EXAMPLES
Engagement	Signage, information campaigns and outreach. Places to gather, such as barbeque or picnic areas. Shared user pathways. Citizen science programs that encourage local residents, workers and visitors to get involved in conservation activities. Stewardship through a potential 'Friends of Redfern Precinct' group. Flagship species – use CoS priority fauna species. Resident led wildlife gardening. Caring for Country initiatives.
Providing alternative resources for people	Provide small insect hotels or planter boxes for residential balconies. Designated dog-friendly areas and walking or biking.

10 Conclusion

10.1 Existing conditions

Given the historical land-use of the sub-precinct and urban location, the proposal site has been comprehensively modified from its original state. The sub-precinct is surrounded by existing roads and a railway line to the south. However, there is some native and non-native vegetation (according to the definition of native vegetation provided in the LLS Act) that has been planted in the proposal site. The trees in the development site are planted amongst pavement, asphalt and small green spaces in car parks and between buildings.

A vegetation integrity score cannot be determined in accordance with Section 5.4 of the BAM as there are no PCTs that will be impacted. There will be no loss of vegetation composition, structure or function (as assessed according to the BAM) because of the proposal. Consequently, the BAM cannot be applied to the proposal to assess direct impacts and an offset cannot be calculated.

Habitat suitability for threatened species is low. Only two threatened fauna species could potentially use the planted *Myrtaceous* street trees in the proposal area for foraging: the Grey-headed Flying-fox and Swift Parrot.

Although located within a 50 km radius of several nationally important Grey-headed Flying-fox camps, the few planted street trees within the proposal site do not meet the criteria for foraging habitat critical to the survival of the Grey-headed Flying-fox outlined in the Draft National Recovery Plan for the Grey-headed Flying-fox.

Assessments of significance were undertaken for the Grey-headed Flying-fox and the Swift Parrot as potential foraging habitat is present in the study area. The proposal is unlikely to significantly affect either of these species. A referral to the Commonwealth Minster for the Environment is not required for potential impacts to biodiversity.

Water quality, water bodies and hydrological processes do not sustain threatened species at the proposal site.

Specific measures to avoid or minimise impacts are commonly determined and refined at the detailed design phase of a project when impacts are known. However, as this project is at the concept design phase specific mitigation measures are limited and should be updated once the detailed design and construction methods are determined for the Sub-precinct. Updated measures should be included in a flora and fauna management sub-plan of the construction environment management plan (CEMP).

Specific measures to avoid and minimise impacts within the study area include:

- Standard fauna salvage protocols for local wildlife during tree removals, such as for birds nesting within the planted mature trees.
- Standard fauna salvage protocols for building removal or building feature removal where applicable, for species such as Gould's Wattled Bat or Possums, that may utilise abandoned buildings.
- Further retention of *Myrtaceae* tree species, including native and non-native species, to support Flying-fox and Swift Parrot intermittently foraging through the study area.
- Further retention or valuation of trees that are classified as 'High' value for Swift Parrot foraging, such as Sugar Gum.
- Removal and long-term management of Australian White Ibis nests in Trees 205, 206 and 209, as well as throughout the site where applicable in future.

10.2 Enhancing urban biodiversity

Given the highly modified nature of the study area as detailed above, the ecology strategy to enhance urban biodiversity intends to find a balance between the proposed design and end-use of the sub-precinct, connecting people with nature in an urban setting and creating habitat for the CoS eight priority species. The overarching objective of the proposed biodiversity enhancement actions are to balance these three competing aims through the creation of multi-functional green spaces, that maximise the urban greening objectives, biodiversity enhancement objectives and CwC objectives of the entire Project.

For this project, the concept of biodiversity creation and value will need to move away from some-what traditional thinking, such as the creation of reserves with locally indigenous flora species, and instead focus on singular elements, such as street trees, garden beds, pocket-parks and planter boxes, to create biodiversity value on a small-scale, which will then combine to create biodiversity across the Precinct as a whole.

Principles to enhance urban biodiversity should include at a minimum:

- Maximised garden space to include:
  - Retention of both native and non-native planted trees and shrubs, with the proposed 100% retention of High value trees and 91% of Medium values trees considered appropriate in this context, with the addition of new plantings (Arterra 2019).
  - Appropriate (diversity and species) planting of existing green space, for example using the 1 m wide tree plots where street trees are planted (Photo 3.3).
  - The addition of habitat treatments for priority fauna species.
  - The addition of smaller-scale greening design elements, such as green walls or planter boxes.
  - The inclusion of logs, rocks and rock piles, undulating grassed areas or shallow water trays or small ponds should be incorporated in green space design (pocket parks), which can also add value as children's play areas.
  - Maximisation of WSUD permeable surface areas for creating or supporting biodiversity, such as the incorporation of raingardens in place of gravel materials, or other habitat treatments to replace hard surfaces.
- A diversity of plantings for pollinating insects and small birds. Choice of flora species to plant should focus on diversity of flowering and fruiting species, rather than on the inclusion of locally indigenous species. The CoS Urban Ecology Strategic Action Plan flora list can be followed, although the final list and placement of plantings, even within planter boxes, should be verified by an expert.
- Mitigation measures for noise and lighting to prevent exclusion of fauna species longer-term. Some larger green space areas should be prioritised for reduced human-use and light at night.

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Appendix A

Threatened species habitat suitability assessment

Table A.1 Likelihood of occurrence assessments of threatened flora species

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Acacia bynoeana (Bynoe's Wattle)	E	V	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with *Corymbia gummifera, Eucalyptus haemastoma, E. gummifera, E. parramattensis, E. sclerophylla, Banksia serrata* and *Angophora bakeri*.	Low. No habitat for this species is present in the study area.
Acacia pubescens (Downy Wattle)	V	V	Restricted to the Sydney Region from Bilpin to the Georges River and also at Woodford where it usually grows in open sclerophyll forest and woodland on clay soils. Typically, it occurs at the intergrade between shales and sandstones in gravely soils often with ironstones.	Low. No habitat for this species is present in the study area.
Acacia terminalis subsp. *terminalis* (Sunshine Wattle)	E	E	Grows in scrub and dry sclerophyll woodland between Botany Bay and the northern foreshore of Port Jackson. The locations from which several of the early collections were made no longer provide habitat, having been cleared for development of the eastern suburbs. Recent collections have been made only from Clifton Gardens, Dover Heights, Parsley Bay, Nielsen Park, Cooper Park, Chifley and Watsons Bay.	Low. There is no suitable habitat in the study area for this species, no individuals were observed during site visit.
Allocasuarina glareicola	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil.	Low. No habitat for this species is present in the study area.
Allocasuarina portuensis (Nielson Park She-oak)	E	E	The original known habitat of the Neilsen Park She-oak is at Nielsen Park, in Woollahra local government area. There are no plants left at the original site where it was discovered. However, propagation material has been planted successfully at a number of locations at Nielsen Park and other locations in the local area, e.g. Gap Bluff, Hermit Point and Vaucluse House.	Low. Individuals are only known from propagated plantings and no longer occurring naturally in the area. None were found during site visit and no suitable habitat is present in the study area for this species to colonise.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Asterolasia elegans	E	E	Occurs on Hawkesbury sandstone. Can be found in sheltered forests on mid to low slopes and valleys and in areas of sheltered forest.	Low. No habitat for this species is present in the study area.
Caladenia tessellata (Thick Lip Spider Orchid)	E	V	Occurs south of Swansea where it grows on clay loam or sandy soils. Prefers low open forest with a heathy or sometimes grassy understorey. Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas/	Low. There is no habitat in the study area suitable for this species. Generalised records of this are present in the Marrickville and Tempe areas but the most favourable habitat is likely to be the Wolli Creek bushland in Earlwood. A historic record from Macdonaldtown over a century ago is not to be considered relevant.
Cryptostylis hunteriana (Leafless Tongue Orchid)	V	V	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats.	Low. There is no habitat in the study area suitable for this species and this species has never been recorded or collected in the locality.
Darwinia biflora	V	V	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas. The northern, southern, eastern and western limits of the range are at Maroota, North Ryde, Cowan and Kellyville, respectively.	Low. There is no habitat in the study area suitable for this species.
Dichanthium setosum (Bluegrass)	V	V	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. Associated species include White Box (Eucalyptus albens), Silver-leaved Ironbark (Eucalyptus melanophloia), Yellow Box (Eucalyptus melliodora) and Manna Gum (Eucalyptus viminalis).	Low. There is a single record from 1913 in Darlinghurst and no others in the locality. Furthermore, there is no habitat in the study area suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Doryanthes palmeri (Giant Spear Lily)	V	-	Giant Spear Lily occurs in far north-east NSW and south-east Queensland. In NSW, it occurs on the coastal ranges that are part of the Mt Warning Caldera on steep cliff-faces or rocky ledges in montane heath next to subtropical rainforest. Its southern distributional limit is Mount Billen. The species is currently known from eleven sites within NSW, five of which are conservation reserves. Most populations consist of only a few hundred individuals.	Low. There is no habitat in the study area suitable for this species and this species has never been recorded or collected in the locality.
Eucalyptus camfieldii (Camfield's Stringybark)	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park.	Low. There is no habitat in the study area suitable for this species.
Eucalyptus nicholii (Narrow-leaved Black Peppermint)	V	V	Occurs from Niangala to Glenn Innes where it grows in grassy sclerophyll woodland on shallow relatively infertile soils on shales and slates, mainly on granite. Endemic on the NSW Northern Tablelands, of limited occurrence, particularly in the area from Walcha to Glen Innes; often on porphyry or granite.	Low. Not recorded. Furthermore, any trees in the Sydney area have been planted as it is not a locally indigenous species.
Eucalyptus pulverulenta (Siver-leafed Gum)	V	V	The Silver-leafed Gum is found in two quite separate areas, the Lithgow to Bathurst area and the Monaro (Bredbo to Bombala). Grows in shallow soils as an understorey plant in open forest, typically dominated by Brittle Gum (Eucalyptus mannifera), Red Stringybark (E. macrorhynca), Broad-leafed Peppermint (E. dives), Silvertop Ash (E. sieberi) and Apple Box (E. bridgesiana).	Low. There is an inaccurate record from Town Hall in 1960 but otherwise this species has not been recorded. Regardless, there is no habitat in the study area suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Genoplesium baueri (Bauer's Midge Orchid)	E	E	The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Haloragodendron lucasii	E	E	The known locations of this species are confined to a very narrow distribution on the north shore of Sydney. Associated with dry sclerophyll forest. Reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Associated with high soil moisture and relatively high soil-phosphorus levels. Flowering occurs from August to November with fruits appearing from October to December.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Hibbertia puberula	E	-	Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Lasiopetalum joyceae	V	V	Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. It is currently known from 34 sites between Berrilee and Duffys Forest. Seventeen of these are reserved. Grows in heath on sandstone.	Low. The habitat in the study area is considered unlikely to be suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Leptospermum deanei (Deane's Tea-tree)	V	V	Occurs in Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Woodland on lower hill slopes or near creeks. Sandy alluvial soil or sand over sandstone. Occurs in Riparian Scrub, Woodland - e.g. Eucalyptus haemstoma; and Open Forest - e.g. Angophora costata	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Macadamia integrifolia (Macadamia Nut)	-	V	Found in remnant forest in northern NSW and south-east QLD, preferring partially open areas such as rainforest edges.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Melaleuca biconvexa (Biconvex Paperbark)	V	V	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area. Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Melaleuca deanei (Deane's Paperbark)	V	V	Occurs in coastal districts, including western Sydney (e.g. Baulkham Hills, Liverpool shires) from Berowra to Nowra where it grows in wet heath on sandstone and shallow/skeletal soils near streams or perched swamps.	Low. There are records of this species from 1901 to 1915 around the Marrickville, Earlwood, Sydenham, Tempe and Wolli Creek areas. There is also an inaccurate record from the Queens Park area. No records of this species have been made in the locality since 1915 and the habitat in the study area is considered unlikely to be suitable for this species.
Persicaria elatior (Tall Knotweed)	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Persoonia hirsuta (Hairy Geebung)	E	E	Occurs in central coast and central tableland districts where it grows in woodland to dry sclerophyll forest on sandstone and rarely shale. Often occurs in areas with clay influence, in the ecotone between shale and sandstone.	Low. Records of this species exist in the Coogee and Tempe areas. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Pimelea curviflora var. *curviflora*	V	V	Confined to coastal areas around Sydney where it grows on sandstone and laterite soils. It is found between South Maroota, Cowan, Narrabeen, Allambie Heights, Northmead and Kellyville, but its former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Usually occurs in woodland in the transition between shale and sandstone, often on Lucas Heights soil landscape.	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Pimelea spicata (Spiked Rice-flower)	E	E	This species occurs in two disjunct areas: in coastal districts from Lansdowne to Shellharbour, and in Cumberland Plain Woodland inland to Penrith. In western Sydney it grows on Wianamatta Shales in Greybox - Ironbark Woodland with Bursaria spinosa and Themeda australis. In the Illawarra, it occurs on well-structured clay soils in grassland or open woodland.	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Prostanthera junonis (Somersby Mintbush)	E	E	Has a north-south range of approximately 19 km on the Somersby Plateau in the Gosford and Wyong local government areas. Is restricted to the Somersby plateau on Hawkesbury sandstone in low/open woodland and open shrubland.	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Prostanthera marifolia (Seaforth Mintbush)	CE	E	Previously thought to be extinct and recently rediscovered. Prostanthera marifolia is currently only known from the northern Sydney suburb of Seaforth; the single population is fragmented by urbanisation into three small sites located within an area of 2x2 km within Manly and Warringah ne site is in the LGAs. Previously occurred in Mangrove Mountain and Sydney districts usually near the coast. Recorded within sclerophyll forest and woodland in sandy loamy soils on sandstone Occurs in the Springwood area where it grows in woodland on lateritic soils.	Low. There are inaccurate records of this species from Darlinghurst. The records have very low accuracy and are considered unlikely to be accurate. There is no habitat in the study area suitable for this species.
Pterostylis saxicola (Sydney Plains Greenhood)	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Two populations occur within a conservation reserve (Georges River National Park; Scheyville NP).	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Rhizanthella slateri (Eastern Underground Orchid)	V	E	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. There has been a recent discovery of this species in the Lane Cove catchment in the Ku-ring-gai LGA. Habitat requirements are poorly understood, and no particular vegetation type has been associated with the species.	Low. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Rhodamnia rubescens (Scrub Turpentine)	CE	CE	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Low. Only records of this species are inaccurate or outdated, no current records of this species exist in the locality. The habitat in the study area is considered unlikely to be suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Rhodomyrtus psidioides (Native Guava)	CE	CE	Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW. 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. No records of this species have been made in the locality and the habitat in the study area is considered unlikely to be suitable for this species.
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	Occurs between Buladelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. 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. There are many records of *Syzygium paniculatum* around urbanised areas of Sydney as this species is commonly planted as street tree and as a hedge plant in gardens. There were no *Syzygium paniculatum* plants found during the field surveys and no natural habitat for this species is present.
Tetratheca juncea (Black-eyed Susan)	V	V	Occurs in coastal districts from Buladelah to Port Macquarie where it grows in dry sclerophyll forest and occasionally swampy heath in sandy, low nutrient soils with a dense understorey of grasses. Specifically it is known to occur within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland.	Low. This species was recorded around the Sydney area from 1905 – 1913. No records of this species have been made in the locality since and the habitat in the study area is considered unlikely to be suitable for this species.
Tetratheca glandulosa	V	-	Restricted to the following Local Government Areas: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest. Vegetation communities correspond broadly to Benson & Howell's Sydney Sandstone Ridgetop Woodland	Low. The habitat in the study area is considered unlikely to be suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Thesium australe (Austral Toadflax)	V	V	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be *Themeda australis* and *Poa* spp.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Distribution and habitat requirement information adapted from Australian Government Department of the Agriculture, Water and the Environment SPRAT http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl and NSW Department of Planning, Industry and Environment Threatened Species Data Collection https://www.environment.nsw.gov.au/threatenedspeciesapp/ Key: EP = endangered population, CE = critically endangered, E = endangered, V = vulnerable				

Table A.2 Likelihood of occurrence assessments of threatened or migratory fauna species

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Anseranas semipalmata (Magpie Goose)	V	-	Common in the Australian northern tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Since the 1980s there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW. Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW.	Low. Known local occurrence only from Queens Park record in 1988. This species has not been recorded in the locality since, and no suitable habitat for this species exists in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Anthochaera phrygia (Regent Honeyeater)	CE	CE	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with Casuarina cunninghamiana and Amyema cambagei are important for feeding and breeding. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum).	Low. There is a record of this species to the west of the study area from 14 George Street Sydenham, recorded in 1996. This is likely to have been a vagrant bird and the habitat in the study area is not considered high quality Regent Honeyeater habitat.
Apus pacificus (Fork-tailed Swift)	-	M	Breeds from central Siberia eastwards through Asia, and is migratory, wintering south to Australia. Individuals never settle voluntarily on the ground and spend most of their lives in the air, living on the insects they catch in their beaks.	Low. This species is considered with a low likelihood to fly over the study area on occasion but is unlikely to utilise the habitat in the study area. This species is commonly recorded in the Sydney region seasonally.
Artamus cyanopterus (Dusky Woodswallow)	V	-	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands and may be seen along roadsides and on golf courses.	Low. This species is known from the Sydney Region, but the study area does not provide any suitable open forest or woodland habitat for this species. It is considered to have a low likelihood of occurrence.
Botaurus poiciloptilus (Australasian Bittern)	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	Low. No suitable habitat for this species exists in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Burhinus grallarius (Bush Stone-curlew)	E	-	Require sparsely grassed, lightly timbered, open forest of woodland. In southern Australia they often occur where there is a well-structured litter layer and fallen timber debris. Feed on a range of invertebrates and small vertebrates, as well as seeds and shoots.	Low. Vagrant birds appear in Sydney suburbs on occasion but are not likely to permanently occupy the habitat in the study area.
Calyptorhynchus lathami (Glossy Black Cockatoo)	V	-	Feeds almost exclusively on the seeds of Casuarina sp. and Allocasuarina sp. Open forest and woodlands up to 1000m with feed trees present.	Low. No suitable habitat for this species exists in the study area.
Cuculus optatus (Oriental Cuckoo)	-	M	Migrates from Eurasia as far south as Indonesia, New Guinea and North Australia. Some remain through Australia in the winter. Inhabits rainforest margins, monsoon forest, vine scrub and mangroves.	Low. The study area is within the known distribution of the seasonal movement patterns of the Oriental Cuckoo but the study area lacks suitable closed forest habitat which this species prefers. As such, it is considered to have a low likelihood of occurrence in the study area.
Dasyornis brachypterus (Eastern Bristlebird)	E	E	The habitat of the Eastern Bristlebird is characterised by low dense vegetation. Fire is a feature of all areas where known populations occur. Given the poor flight ability of the species it is though that few individuals survive the passage of fire, survival is dependent on the availability of fire refuges and recolonisation may be relatively slow. Confined to NSW/Queensland border region, Illawarra region and NSW/Victorian border region.	Low. No suitable habitat for this species exists in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Epthianura albifrons (White Fronted chat - population in the Sydney Metropolitan Catchment Management Area)	V, EP	-	In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	Low. Although a population exists in the Sydney Olympic Park area, most recordings in the locality of the study area are inaccurate or outdated. However, one record exists of a pair in Macdonaldtown in 2019. There is no habitat considered suitable for this species in the study area and it is unlikely however close this record was, that they would occur on site.
Erythrotriorchis radiatus (Red Goshawk)	CE	V	Occurs sparsely through northern and eastern Australia from Western Australian Kimberley division to north eastern Queensland and south to far north-eastern NSW with scattered records in central Australia. Inhabit open woodland and forest preferring mosaic of vegetation types. Often found in riparian habitats along or near watercourses or wetlands.	Low. This species has not been recorded in the locality except for one inaccurate historical record. No suitable habitat for this species exists in the study area.
Falco hypoleucos (Grey Falcon)	E	-	Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range. There are possibly less than 5000 individuals left. Population trends are unclear, though it is believed to be extinct in areas with more than 500mm rainfall in NSW. 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.	Low. This species has not been recorded in the locality and it is unlikely habitat in the study area is suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Grantiella picta (Painted Honeyeater)	V	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it would take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks.	Low. This species has not been recorded in the locality and the Sydney city area is not known as a location for this species. The habitat in the study area is not considered suitable for this species
Haliaeetus leucogaster (White-bellied Sea-Eagle)	V	-	The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways.	Low. The habitat in the study area is not considered suitable for this species.
Hieraaetus morphnoides (Little Eagle)	V	-	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet.	Low. The habitat in the study area is not considered suitable for this species.
Hirundapus caudacutus (White-throated Needletail)	-	V, M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April.	Low. This species is considered likely to fly over the study area on occasion but is unlikely to utilise the habitat in the study area. This species is commonly recorded in the Sydney region seasonally.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Lathamus discolor (Swift Parrot)	E	CE	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands.	Low No significant foraging habitat for this species is present in the study area. However due to a large variety of mature native trees floral feed trees may attract the occasional vagrants.
Lophoictinia isura (Square-tailed Kite)	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, E. maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Low. No significant foraging habitat for this species is present in the study area.
Monarcha melanopsis (Black-faced Monarch)	-	M	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating.	Low. This species is considered unlikely to utilise the habitat in the study area during seasonal movements as no suitable rainforest or closed forest habitat is present.
Monarcha trivirgatus (Spectacled Monarch)	-	M	Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed.	Low. This species is considered unlikely to utilise the habitat in the study area during seasonal movements as no suitable rainforest or closed forest habitat is present.
Motacilla flava (Yellow Wagtail)	-	M	Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	Low. Any birds of this species that may visit to study area would be vagrant birds. The habitat in the study area is unsuitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Myiagra cyanoleuca (Satin Flycatcher)	-	M	Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens.	Low. This species is considered unlikely to utilise the habitat in the study area during seasonal movements, as no suitable habitat is present.
Neophema chrysogaster (Orange-bellied Parrot)	CE	CE	Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured but they would turn up anywhere within these coastal regions.	Low. This species is considered unlikely to utilise the habitat in the study area as no suitable habitat is present. This species has a very small population and any birds that may occur in Sydney in winter would be vagrants.
Ninox connivens (Barking Owl)	V	-	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	Low. No suitable foraging or breeding habitat is present.
Ninox strenua (Powerful Owl)	V	-	A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, casuarina or callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally, feeds on medium-sized mammals such as possums and gliders but would also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands.	Low. No suitable foraging or breeding habitat is present.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Numenius madagascariensis (Eastern Curlew)	-	CE	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	Low. The habitat in the study area is not considered suitable for this species
Numenius minutus (Little Curlew)	-	M	Little Curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast. The Little Curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated.	Low. No suitable foraging or breeding habitat is present.
Petroica boodang (Scarlet Robin)	V	-	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter.	Low. No suitable habitat is present in the study area for this species.
Ptilinopus superbus (Superb Fruit-Dove)	V	-	Occurs in rainforests and fringes, scrubs, mangroves and wooded stream-margins, lantana thickets, isolated figs, pittosporums, lilly pillies and blackberries.	Low. There are some records of this species from St Peters in 1995. However, this bird is likely to have been a vagrant and was relocated by WIRES. No suitable habitat for this species is present in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Rhipidura rufifrons (Rufous Fantail)	-	M	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range.	Low. This species has not been recorded in the study area and is considered to have a low likelihood of occurrence due to the absence of suitable habitat.
Stagonopleura guttata (Diamond Firetail)	V	-	Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feeds on seeds, mostly of grasses.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Stictonetta naevosa (Freckled Duck)	V	-	Found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	Low. The habitat in the study area is considered unlikely to be suitable for this species.
Mammals				

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	Low. This species has not been recorded in the study area in the past and no suitable roosting habitat (i.e. sandstone caves) or foraging habitat is present.
Dasyurus maculatus (Spotted-tail Quoll)	V	E	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Low. This species has not been recorded in the locality and the study area does not provide any suitable habitat for this species.
Isoodon obesulus obesulus (Southern Brown Bandicoot)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	Low. This species has not been recorded in the locality and the study area does not provide any suitable habitat for this species.
Micronomus norfolkensis (Eastern Coastal Freetailed-bat)	V	-	The Eastern Freetail-bat is found along the east coast from south QLD to southern NSW. Occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark.	Low This species is known to occur in the suburbs of Sydney. However, no suitable roosting or foraging habitat for this species is present in the study area.
Miniopterus australis (Little Bentwing-bat)	V	-	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Low. This species is known to occur in the suburbs of Sydney. However, no suitable roosting or foraging habitat for this species is present in the study area.
Miniopterus orianae oceanensis (Large Bent-winged Bat)	V	-	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	Low. This species is known to occur in the suburbs of Sydney. However, no suitable roosting or foraging habitat for this species is present in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Myotis macropus (Southern Myotis)	V	-	Roosts in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	Low. While there are records of this species from the locality, no suitable roosting or foraging habitat for this species is present in the study area.
Perameles nasuta (Long-nosed Bandicoot population in inner western Sydney)	EP	-	The exact area occupied by the population is not clearly defined and includes the local government areas (LGA) of Marrickville and Canada Bay, with the likelihood that it also includes Canterbury, Ashfield and Leichhardt LGAs. Future research may better define the population and possibly indicate a wider distribution. This population is disjunct from the nearest records of the Long-nosed Bandicoot, which occur north of the Parramatta River or much further south at Holsworthy Military Reserve.	Low. There is no suitable habitat for this species is present in the study area. Outside the known LGA's for this species.
Petauroides volans (Greater Glider)	-	V	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria. This species feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and would use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha.	Low. There is no suitable habitat for this species is present in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Petrogale penicillata (Brush-tailed Rock Wallaby)	E	V	The range of the brush-tailed rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However, the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Low. There is no suitable habitat for this species is present in the study area.
Phascolarctos cinereus (Koala)	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. 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 would select preferred browse species.	Low. There is no suitable habitat for this species is present in the study area.
Pseudomys gracilicaudatus (Eastern Chestnut Mouse)	V	-	In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. There are however isolated records in the Jervis bay area. Mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again.	Low. There is no suitable habitat for this species is present in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Pseudomys novaehollandiae (New Holland Mouse)	-	V	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	Low. There is no suitable habitat for this species is present in the study area.
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. 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.	Moderate. No Grey-headed Flying-fox camps are located in or near the study area. However due to a large variety of mature native trees floral feed trees may attract individuals occasionally.
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V	-	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	Low. No breeding habitat is present. The study area, particularly the vegetation to be removed does not represent foraging habitat for this species.
Frogs				

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Heleioporus australiacus (Giant Burrowing Frog)	V	V	In the northern population there is a marked preference for sandstone ridgetop habitat and broader upland valleys. In these locations the frog is associated with small headwater creeklines and along slow flowing to intermittent creeklines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from the collected water. They have also been observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised over time and are still surrounded by other undisturbed habitat.	Low. There is no suitable habitat for this species is present in the study area.
Litoria aurea (Green and Golden Bell Frog)	E	V	Various types of habitat utilised has been documented. For breeding utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral locations that are more often dry than wet. Is found in various small pockets of habitat in otherwise developed areas and has the tendency of often turning up in highly disturbed sites.	Low. No suitable habitat is present in the study area.
Mixophyes balbus (Stuttering Frog)	E	V	Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only Mixophyes species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Low. No suitable habitat is present in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Pseudophryne australis (Red-crowned Toadlet)	V	-	A brown to black frog with a bright red orange triangle on the head. Length is appox 30mm. The toadlet has restricted distribution, it is confined to the Sydney basin form Polkolbin in the north. Inhabits wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks amongst masses of dune vegetation or thick piles of leaf litter.	Low. No suitable habitat is present in the study area.
Reptiles				
Hoplocephalus bungaroides (Broad-headed Snake)	V	V	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 hollows in large trees within 200 m of escarpments in summer.	Low. There is no suitable habitat for this species is present in the study area.
Invertebrates				
Petalura gigantea (Giant Dragonfly)	E	-	The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. Live in permanent swamps and bogs with some free water and open vegetation. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. They hunt for flying insects over the swamp and along its margins.	Low. There is no suitable habitat for this species is present in the study area.
Pommerhelix duralensis (Dural Land Snail)	-	E	Occurs in low densities along the western and northwest fringes of the Cumberland IBRA. Known to occur far north of St Albans, along the footslopes of the Blue mountains as far south as The Oaks. Habitats include shale-derived and sandstone derived soils with forested habitats that have good native cover and woody debris. Favours sheltering under rocks or inside bark, does not burrow or climb. Rests in exposed areas such as rocks or leaf litter.	Low. There is no suitable habitat for this species is present in the study area.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	DISTRIBUTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Notes: some species returned from the database searches such as turtles, whales, dolphins, fish, sharks, shorebirds, marine birds, wetland birds and waders have been excluded from this assessment, as the study area does not provide any habitat for these species. Distribution and habitat requirement information adapted from Australian Government Department of Agriculture, Water and the Environment SPRAT http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl and NSW Department of Planning, Industry and Environment Threatened Species Data Collection https://www.environment.nsw.gov.au/threatenedspeciesapp/ Key: EP = endangered population, CE = critically endangered, E = endangered, V = vulnerable, M = migratory				

Appendix B

BC Act assessments of significance

B1 BC Act assessments of significance

An Assessment of Significance has been conducted for threatened biodiversity that have been positively identified or that have a moderate or higher likelihood of occurring and being impacted by the proposal.

Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threat-listed species, populations or ecological communities listed under the BC Act. These tests of significance have been undertaken in accordance with the guidelines provided in the Threatened Species Test of Significance Guidelines (Office of Environment and Heritage 2018) which outlines a set of criteria to guide applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the 5-part test.

The only threatened species that is considered moderately likely to utilise the habitat within the proposal footprint is the Grey-headed Flying-fox. The Grey-headed Flying-fox is likely to forage on planted Myrtaceous street trees. Blossom nomads such as the Swift Parrot may also forage on the flowering trees on rare occasion, but the likelihood of this occurring is considered low and any impact to the Swift Parrot would be negligible. A precautionary approach has been applied to the assessment of the Swift Parrot.

B1.1 Grey-headed Flying-fox and Swift Parrot

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Grey-headed Flying-fox occurs 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. Annual mating commences in January and conception occurs in April or May; a single young is born in October or November. There are no roost camps located in the development footprint the proposal would not directly impact on any known breeding / maternity site. As such, the impacts of the proposal to the Grey-headed Flying-fox would be limited to loss of foraging habitat in the form of planted trees.

The Swift Parrot breeds in Tasmania and as such this important component of the lifecycle of this species will not be impacted by the proposal. The foraging resource to be impacted is not considered important for this species and the impacts on the life cycle of the Swift Parrot would be negligible.

The affected area of foraging habitat for these three species would represent a very small percentage of the total extent of foraging habitat present within the locality. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat located near the study area, the proposal is not expected to significantly affect the life cycle of these species. Any viable local populations will not be placed at risk of extinction from the proposal.

b in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction or

ii is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

c In relation to the habitat of a threatened species or ecological community:

i the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

iii the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The potential habitat within the study area is limited to foraging habitat. The extent of potential existing foraging habitat would be reduced by 8%, based on the retention of 91% of the tree canopy proposed by Arterra (Arterra 2019). This amount of habitat removal is small when the amount of available foraging habitat in the locality is considered.

Although located within a 50 km radius of several nationally important Grey-headed Flying-fox camps, the few planted street trees within the proposal site do not meet the criteria for foraging habitat critical to the survival of the Grey-headed Flying-fox outlined in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW, 2009) because the streets trees are not:

- productive during winter and spring, when food bottlenecks have been identified
- known to support populations of > 30 000 individuals within an area of 50 km radius
- productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
- productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)
- known to support a continuously occupied camp.

Importantly, the proposal would not result in fragmentation of habitat. These species are highly mobile and will freely fly long distances (50+ km) over open areas including urbanised city centres to move between roost sites and foraging sites. The proposal would not affect the movement of these species between habitat patches.

Importantly, the proposal would not affect the most important habitats for these species within the locality. The most important habitats for the local Grey-headed Flying-fox in the locality are camps and large areas of reliable foraging resources. The most important habitats for the Swift Parrot are the coastal forests that support a significant number of trees that provide a foraging resource. The foraging habitat within the study area is likely to form part of an overall foraging range for these species and would only form a small proportion of available habitat for these species. As such, the foraging habitat within the development footprint is unlikely to be of critical importance for the survival of these species in the locality.

d whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposal will not impact on any declared area of outstanding biodiversity value.

e whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, nine are applicable to this assessment. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs except for clearing of native vegetation.

Conclusion

There is a minimal reduction in the extent of marginal foraging habitat from the proposal, but no breeding habitat would be affected suggesting the life-cycle of these species would not be impacted such that a viable local population of these species is unlikely to be placed at risk of extinction. The extent of impact is negligible. Fragmentation of habitat for these species will not occur. The habitat to be impacted is not considered important to the long-term survival of these species in the locality.

After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to the Grey-headed Flying-fox and Swift Parrot.

Appendix C

EPBC Act assessments of significance

C1 EPBC Act assessments of significance

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment 2013). This advice has been considered while undertaking the assessments.

C1.1 Grey-headed Flying-fox

The Grey-headed Flying-fox exists as one interconnected population along the eastern Australian coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. As a result, for this assessment, the impact has been considered in terms of 'important habitat' as opposed the presence of an 'important population'.

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

1 lead to a long-term decrease in the size of an important population of a species

There are no roost camps in the development footprint and the proposal would not affect any known permanent roosting, breeding / maternity site. Therefore, it is likely that the impacts of construction and operation of the proposal would be confined to minor loss of foraging habitat caused by direct clearing or damage to vegetation during the construction phase.

Of the 290 trees and shrubs recorded, the proposal would remove 24 planted Myrtaceous street trees.Given the relatively widespread nature of similar native vegetation and planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of local individuals, the proposal is not expected to significantly affect important habitat or lead to a long-term decrease in the size of an important population.

2 reduce the area of occupancy of an important population

The area of occupancy of the Grey-headed Flying-fox is not known but the species exists as one interconnected population along the eastern Australian coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. The area occupied by this species would remain the same after the proposal. No decrease in the area of occupancy for this species expected as a result of the proposal.

3 fragment an existing important population into two or more populations

Highly mobile species such as bats are expected to be less impacted by fragmentation. The Grey-headed Flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom in differing parts of the landscape. The proposal would not fragment an important population of the Grey-headed Flying-fox. Individuals would still be able to disperse between roosts along the east Australian coast. Genetic exchange within the population and dispersal would not be disrupted by the proposal.

4 adversely affect habitat critical to the survival of a species

This species typically exhibits very large home range and Grey-headed Flying-fox is known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources. There are no known roost camps within the development site and the site does not provide typical or likely roosting habitat. However, there are a number of known

roost camps with a 50km radius of the proposal. The draft recovery plan for the Grey-headed Flying-fox identifies critical foraging habitat for this species as:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals, within an area of 50-kilometre radius of a camp site
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- Known to be continuously occupied as a camp site

The foraging habitat in the development site is unlikely to constitute critical foraging habitat. Given the extensive nature of high-quality foraging habitats within the range of local bats, the proposal is not expected to adversely affect foraging habitat critical to the survival of this species in this region.

5 disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat, but the proposal would not directly impact on a known or likely roost camp / breeding or maternity site. Extensive foraging resources are available in the locality that would provide suitable resources during the maternity season. The habitats in the development site are not limiting for this species.

6 modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The impacts to foraging habitat are likely to be negligible. The proposal is not expected to lead to a decline in the species in this region considering the magnitude of this impact and the expanse of high-quality foraging habitat available to local animals.

7 result in invasive species that are harmful to a vulnerable species becoming established in the Vulnerable species' habitat

The proposal is unlikely to result in an invasive species harmful to the Grey-headed Flying-fox becoming established in the habitat. The potential for weed invasion with a proposal of this nature is minimal given the site context.

8 introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species of relevance to the proposal. The proposal would be unlikely to increase the potential for significant disease vectors to affect local populations.

9 interfere substantially with the recovery of the species.

The Draft National Recovery Plan for the Grey-headed Flying-fox (Pteropus poliocephalus) (Department of Environment Climate Change and Water 2009) outlines the following actions:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox

- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan

The recovery actions listed above are largely not applicable to the proposal and the proposal is not expected to interfere appreciably with the recovery of the species.

Conclusion

The Grey-headed Flying-fox would be subject to a small reduction in extent of marginal foraging habitat from the proposal. No breeding camps or other important habitat would be impacted. The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The proposal would not interfere with the recovery of the Grey-headed Flying-fox and would not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox.

C1.2 Swift Parrot

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

1 lead to a long-term decrease in the size of an important population of a species

The development footprint contains some potential foraging habitat for the Swift Parrot. While the habitat in the development footprint is marginal, the loss of potential feed trees would directly affect the species opportunity to feed in the area. However, the development footprint is not considered a critical area for the Swift Parrot. The Swift Parrot may utilise trees in the development footprint for foraging intermittently when no other suitable inland (i.e. box ironbark woodlands) or coastal resources (i.e. Spotted Gum and Swamp Mahogany forests) are available.

The Swift Parrot does not breed in the study area and the small amount of habitat remaining in the study area is of marginal suitability. Thus, the action is unlikely to lead to a long-term decrease in the size of the Australian population.

2 reduce the area of occupancy of an important population

As a specialist nectarivore dependent on flowering eucalypts, Swift Parrots are vulnerable to the loss of quantity and quality of key forage tree species. As a large-scale migrant, it has the ability to cover vast areas of its winter range, seeking suitable flowering eucalypt habitat. The species is an occasional visitor to the region and may utilise trees in the study area for foraging intermittently when no other suitable resources are available.

The proposal would contribute very slightly to the loss of potential foraging habitat and would have a negligible impact on the area of habitat available. The action will not reduce the area of occupancy of this species which is estimated at 4,000 km^2.

3 fragment an existing important population into two or more populations

The action will not result in fragmentation of habitat for the Swift Parrot. This species is highly mobile and as a regular behaviour flies long distances over open areas to move between suitable foraging habitats. The action will not affect the movement of the Swift Parrot between habitat patches or fragment the population

4 adversely affect habitat critical to the survival of a species

Key habitats for this species on the coast and coastal plains of New South Wales include large stands of Spotted Gum (*Corymbia maculata*), Swamp Mahogany (E. robusta), Red Bloodwood (*Corymbia gummifera*) and Forest Red Gum (*E. tereticornis*) forests. The habitat within the study area is considered to be marginal habitat for the Swift Parrot as this species is not regularly recorded from the area, the habitat is highly modified, and it is not known as critical habitat.

5 disrupt the breeding cycle of an important population

The Swift Parrot is endemic to south-eastern Australia, breeds only in Tasmania, and migrates to mainland Australia in autumn. As such, the proposal will not impact on breeding habitat for this species. Important winter foraging grounds will not be impacted.

6 modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

As a large-scale migrant, this species can cover vast areas of its winter range, seeking suitable flowering eucalypt habitat. The species is an occasional visitor to the region and may utilise trees in the study area for foraging intermittently when no other suitable resources are available. The proposal is unlikely to 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 vulnerable species becoming established in the Vulnerable species' habitat

Weed invasion is considered possible with a proposal of this nature and appropriate controls are required during construction and operation to reduce this threat.

8 introduce disease that may cause the species to decline, or

Beak and feather disease affecting endangered psittacine species is listed as a Key Threatening Process (KTP) potentially affecting this species. There is no mechanism by which the proposal could introduce or exacerbate this or any other disease potentially affecting the species. The proposal would be unlikely to increase the potential for significant disease vectors to affect the species.

9 interfere substantially with the recovery of the species.

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) identifies the following actions for recovery of this species:

- Identify the extent and quality of habitat.
- Manage and protect Swift Parrot habitat at the landscape scale.
- Monitor and manage the impact of collisions, competition and disease.
- Monitor population and habitat.

The recovery actions listed above to help recover the Swift Parrot are generally not applicable to the proposal. The proposal will not interfere appreciably with the recovery of the Swift Parrot.

Conclusion

The Swift Parrot will be subject to a negligible reduction in extent of marginal foraging habitat from the proposal. The proposal is unlikely to reduce the population size of the Swift Parrot or decrease the reproductive success of this species. The proposal will not interfere appreciably with the recovery of the Swift Parrot.

After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Swift Parrot.