



Transport
for NSW

Henry Lawson Drive Upgrade (Stage 1A), between Keys Parade and Tower Road

Biodiversity Assessment Report

Transport for NSW | July 2021

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Prepared by WSP and Transport for NSW




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Executive summary

Introduction

Transport for NSW (Transport) is proposing to upgrade Henry Lawson Drive between Keys Parade, Milperra, to Tower Road, Bankstown Aerodrome (known as Henry Lawson Drive Upgrade Stage 1A) (the overall proposal). The overall proposal consists of upgrading a 1.3 kilometre length of Henry Lawson Drive and an additional 480 metres along Milperra Road, including intersection upgrades.

The overall proposal forms the first stage of the progressive upgrade to 7.5 kilometres of Henry Lawson Drive between the intersections of Hume Highway, Villawood, and the M5 South Western Motorway, Milperra.

The upgrade would help ease existing traffic issues and increase traffic capacity at key intersections to help meet growing demand, with residential, commercial and industrial development in the surrounding area expected to increase in the coming years. The upgrade would be delivered in three stages.

The REF proposal incorporates the majority of the overall proposal, however, excludes works which are located within the SEPP (Coastal Management) area and assessed as designated development in the EIS (the EIS proposal). This Biodiversity Assessment Report focusses on the REF proposal. A separate report, Biodiversity Development Assessment Report, focusses on the EIS proposal.

This Biodiversity Assessment Report has been prepared to assess the potential biodiversity impacts of the REF proposal. It supports a Review of Environmental Factors (REF) being prepared by Transport under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and an Environmental Impact Statement (EIS) being prepared under Division 4.1 of the EP&A Act.

Methodology

A combination of desk-based research and field assessment was used to develop an appreciation of the existing environment of the study area to inform the impact assessment. The field survey aimed to ground truth the results of the background research and habitat assessment. As such, all threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence.

Vegetation and flora surveys

Initial native vegetation surveys were undertaken by WSP (2019) over an eight-day period on the 21 to 25 & 31 May, 1 & 21 of June 2018. Additional field surveys were undertaken on the 6 & 7 April, 29 & 30 September and 1 October 2020. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitat, especially for threatened species, populations and ecological communities. The field surveys aimed to ground truth the results of the background research including desktop analysis of vegetation and habitat assessment. The floristic diversity and possible presence of threatened species was assessed using a combination of survey techniques including; plot-based (quadrat/transect) (14 plots were completed), rapid point assessments and parallel line transverses in accordance with the relevant guidelines.

Data on geology, dominant canopy species, native diversity, vegetation structure and condition was collected across the study area to validate and refine existing vegetation classifications and to determine the associated Plant Community Type (PCT) in accordance with the BioNet Vegetation Classification (Environment Energy and Science, 2021c). Vegetation zones and conditions were identified and mapped following the BAM (Department of Planning Industry and Environment, 2020a). This was based on field verification of the PCT, class and formation as outlined in BioNet Vegetation Classification (Environment Energy and Science, 2021c).

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence in the study area. Targeted flora surveys were completed by conducting reference checks, parallel line traverses, random meanders and during BAM plot surveys.

Fauna surveys

Targeted threatened fauna surveys involved:

- Fauna habitat assessment 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 within the study area.
- Nocturnal surveys consisted of spotlighting and call playback, targeting threatened owls, threatened arboreal mammals and threatened amphibians.
- 20-minute diurnal bird searches completed by actively walking through the nominated site (transect) over a period of 20-minutes (this included areas of potential shorebird habitat).
- Remote motion sensing infra-red cameras were positioned in the study area/subject land to target arboreal mammals (e.g. Squirrel Glider).
- Spot Assessment Technique (SAT) was undertaken to identify the presence of Koala usage within the habitats.
- Active invertebrate searches involved diurnal hand searches (i.e. disturbance of habitat) and visual searches targeting Cumberland Plain Land Snail.
- Ultrasonic Anabat bat detection was used to record and identify the echolocation calls of insectivorous bats foraging across the study area.
- Daytime inspections of culverts and bridges were undertaken within the study area and subject land to identify potential bat roosting sites.
- Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted
- The aquatic habitats within the study area were assessed against the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013) and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). The condition of the aquatic habitat was assessed using a modified version of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman et al., 1997).

Existing environment

The study area is situated within the Sydney Basin Bioregion, specifically the Cumberland subregion. The study area is across the Ashfield Plains and Georges River Alluvial Plain NSW landscape (Mitchell landscape). The main waterway is the Georges River and associated tributaries. There are no areas of outstanding biodiversity value within the study area or locality (within 10km of the study area).

Plant community types

A total of seven NSW Plant Community Types (PCTs) were recorded in the study area. These are:

- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – moderate condition
- PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 – Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 920 – Mangrove Forest in Estuaries of the Sydney Basin and South East Corner
- PCT 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

These seven native vegetation communities (listed above) were assigned to 14 discrete vegetation zones based on broad vegetation condition class criteria.

In addition, three non-native vegetation types were assigned to a miscellaneous ecosystem class, being:

- miscellaneous ecosystem – urban exotic/native landscape plantings
- miscellaneous ecosystem – weeds/exotics – non- native vegetation
- miscellaneous ecosystem – waterbodies.

Threatened ecological communities

Four threatened ecological communities (TECs) listed under the BC Act were recorded within the REF proposal study area as follows:

- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Groundwater dependent ecosystems

GDEs which are surface expressions of groundwater within the locality of the study area (<10 km) include the Georges River. Other GDEs which are reliant on subsurface groundwater in the study area include:

- PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 – Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 920 – Mangrove Forest in Estuaries of the Sydney Basin and South East Corner
- PCT 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

Threatened species and populations

Threatened flora species

Based on the results of the likelihood of occurrence assessments, 58 threatened flora species were known or predicted to occur in the locality, including an additional two endangered populations, of which 17 have been identified as having a moderate or higher likelihood of occurring within the study area. These 17 threatened flora species became the focus of detailed targeted surveys that resulted in the identification of two species within the study area: *Acacia pubescens* (Downy Acacia) and *Callistemon linearifolius* (Netted Bottle Brush). Twelve individuals of *Acacia pubescens* (listed as vulnerable under the BC Act and the EPBC Act) were recorded within Ashford Reserve along Milperra Road. Twenty-nine *Callistemon linearifolius* specimens (listed as vulnerable under the BC Act) were tentatively recorded from within and adjoining Ashford Reserve in the study area.

Threatened fauna species

The results of the likelihood of occurrence assessments identified 94 threatened fauna species as known or predicted to occur in the locality of which 16 were identified as having a moderate or higher likelihood of occurring within the study area. The results of the fauna surveys indicate that the following species use the study area, or their habitats are present:

- Dusky Woodswallow is considered to have a moderate likelihood of occurring within the study area due to the presence of potential foraging habitat (open eucalypt forest).
- The study area contains several blossoming trees that represent potential foraging habitat for the Swift Parrot and Little Lorikeet.
- Varied Sittella is considered to have a moderate likelihood of occurring within the study area due to the presence of potential habitat (eucalypt forest) and has been recorded within the wider locality.
- The White-bellied Sea-eagle was considered to have a moderate likelihood of occurring . No nests or potential nesting trees were recorded in the study area.
- The White-throated Needletail may occur over the study area on a seasonal basis, but unlikely to use terrestrial habitats in the study area.
- Southern Myotis was found to be roosting in a culvert in the northern section of the study area. Cave dwelling Insectivorous bat species including Little Bent-winged Bat and Large Bent-winged Bat, which occur in the locality, are likely to use the site for foraging on an intermittent basis.
- Tree roosting Insectivorous bat species including Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat and Greater Broad-nosed Bat may use the study area.

- A Grey-headed Flying-fox considered to have a moderate likelihood of occurring. There are numerous records within the locality. The study area does not contain roosting camps, but the study area does contain potential foraging in the form of flowering tree species.

Aquatic habitat

All river and creek reaches within the REF proposal area are tidal and hence are considered estuarine. Other waterbodies and wetlands in the study area include a series of small wetlands along the northern and western perimeter of Bankstown Golf Club, bounded by Henry Lawson Drive to the west and Milperra Road to the north, and Milperra Drain which drains the golf course, flowing westward under Henry Lawson Drive to the border of Gordon Parker Reserve, Milperra.

The waterways at all surveyed habitat assessment sites were in moderate condition (RCE scores varying from 29 to 38) with the scores largely driven by relatively wide riparian zones composed of native and exotic trees and shrubs, fully stabilised banks, medium to deep channel form (apart from artificial waterways), and little channel sediment accumulation. The Georges River is the only mapped Key Fish Habitat in the study area and has a waterway classification of Class 1: Major key fish habitat with habitat sensitivity Type 2: Moderately sensitive key fish habitat. In the study area the banks of the Georges River are lined by seedlings, shrubs and trees of River mangroves (*Aegiceras corniculatum*) and Grey mangroves (*Avicennia marina*) (PCT 920).

Based on the review of the Fisheries Spatial Data Portal (freshwater threatened species maps), the freshwater fish community of the Georges River is rated as Good (based on data derived from fish sampling records 2009–2011). However, habitat for threatened freshwater fish is not mapped in the Georges River. The threatened fish species returned from the PMST search including Macquarie Perch and Black Rockcod are not known to occur in the study area.

Wildlife connectivity corridors

The REF proposal is considered unlikely to result in a large increase to landscape scale fragmentation and to further limit connectivity and movement corridors than what already exists in the study area, as it largely follows existing roadways. The impacts from the REF proposal would largely involve ‘trimming’ the edges of vegetation patches adjacent to the existing road corridor, which would not result in additional habitat fragmentation. The REF proposal is however likely to result in a reduction in vegetation patch sizes of the regional wildlife patches along the Georges River. The predicted impacts from the REF proposal is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. The existing functional connectivity for many species would remain in the study area.

Matters of National Environmental Significance

Wetlands of International Importance

One wetland of international importance (Ramsar) occurs within 10km of the study area which is the Towra Point Nature Reserve. Additionally, the REF proposal occurs downstream of a nationally important wetland, Voyager Point wetland. Given the distance of the REF proposal from Towra Point Nature Reserve and Voyager Point wetland there will not be any direct impact from the REF proposal and indirect downstream impacts are also predicted to be negligible. The REF proposal is unlikely to impact any wetlands of international importance.

Threatened Ecological Communities

The study area contains vegetation corresponding to three EPBC Act listed TECs as follows:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

Threatened species

A population of *Acacia pubescens* (listed as Vulnerable) was recorded during the field survey on the southern side of Milperra Road within Ashford Reserve. The targeted flora surveys did not record any other EPBC Act listed threatened flora species from within or directly adjacent to the study area.

The three EPBC Act listed threatened fauna species that are considered at least moderately likely to occur within the study area on occasion based on the presence of suitable habitat include:

- Swift Parrot (listed as Critically Endangered)
- White-throated Needletail (listed as Vulnerable)
- Grey-headed Flying-fox (listed as Vulnerable).

Listed migratory species

The two listed Migratory species that have potential to occur in the study area are the White-throated Needletail and Eastern Osprey. However, the habitats in the study area are unlikely to constitute important habitat for any of the listed migratory species. The habitat present in the study area was unlikely to support significant proportions of populations of any migratory species nor are the habitats in the study area critical to any life stage of identified species. Due to their mobile nature, these species are likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur. Because of this, these species are not considered to be significantly impacted by the REF proposal.

Impact assessment

The summary of proposed native vegetation removal for the REF proposal area is presented in the table below. The impacts represented below and assessed in this report are based on the REF proposal concept design and are indicative only. As design progresses through detailed design these estimates of native vegetation removal would be updated.

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region	Area (ha) REF proposal area
PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Moderate condition	E	CE	95%	0.21
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Moderate condition	E	–	74%	0.07
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Moderate condition – Forest Red Gum variant	E	CE	93%	0.77
	Moderate condition – Blue Box variant				0.19
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Poor condition	E	–	32%	0.14
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Moderate condition	E	E	90%	0.10
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Poor condition	E	E	60%	0.21
Total extent of native vegetation impact					1.69

Two threatened flora species, *Callistemon linearifolius* listed as vulnerable under the BC Act and *Acacia pubescens* listed as vulnerable under the BC Act and the EPBC Act were recorded within the study area. *Callistemon linearifolius* will be affected by the REF proposal via the direct removal of approximately 23 individuals along the southern road-side verge of Milperra Road, with a population being retained in Ashford Reserve. *Acacia pubescens* would not be directly impacted.

Field surveys recorded one threatened fauna species utilising habitat within the study area including:

- Southern Myotis (*Myotis macropus*) listed as Vulnerable under the BC Act.

The REF proposal would result in the removal of foraging habitat for this species. The box culvert in which the Southern Myotis was recorded would not be impacted.

The predicted impact to the threatened fauna species utilising habitat in the REF proposal area is outlined in the table below:

Species	Potential occurrence	Habitat impacted by REF proposal	Impact (ha/ individuals)
<i>Artamus cyanopterus cyanopterus</i> (Dusky Woodswallow)	Moderate	PCT 725, PCT 835	1.17
<i>Pandion cristatus</i> (Eastern Osprey)	Moderate	PCT 835, PCT 1234, PCT 1800	1.27
<i>Glossopsitta pusilla</i> (Little Lorikeet)	Moderate	PCT 725, PCT 835	1.17
<i>Lathamus discolor</i> (Swift Parrot)	Moderate	PCT 725, PCT 835	1.17
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	Moderate	PCT 725, PCT 835	1.17
<i>Haliaeetus leucogaster</i> (White-bellied Sea-eagle)	Moderate	PCT 835, PCT 1234, PCT 1800	1.27
<i>Hirundapus caudacutus</i> (White – throated Needletail)	Moderate	PCT 725, PCT 835	1.17
<i>Miniopterus australis</i> (Little Bent-winged Bat)	Moderate	All PCTs	1.69
<i>Miniopterus orianae oceanensis</i> (Large Bent - winged Bat)	Moderate	All PCTs	1.69
<i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle)	Moderate	All PCTs	1.69
<i>Mormopterus norfolkensis</i> (Eastern Coastal Free – tailed Bat)	Moderate	All PCTs	1.69
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	Moderate	All PCTs	1.69
<i>Myotis macropus</i> (Southern Myotis)	Recorded	PCT 835, PCT 1234, PCT 1800	1.27
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheathtail Bat)	Moderate	PCT 725, PCT 835	1.17
<i>Pteropus poliocephalus</i> (Grey Headed Flying Fox)	Moderate	PCT 725, PCT 835	1.17

The overall outcome of the tests of significance and EPBC Act assessments of significance (see Appendix D) indicate that it is unlikely that the REF proposal will have significant impact upon threatened species, ecological communities, populations or their habitat. Given the REF proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement (SIS) is not required under the BC Act to support this REF proposal.

This biodiversity assessment identified that the REF proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act. In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

Due to the relatively minor extent of excavations and the implementation of environmental groundwater safeguards it is unlikely that interception of groundwater flows would significantly affect groundwater dependent ecosystems within the study area. The REF proposal is not expected to substantially interfere with subsurface or groundwater flows associated with the Georges River.

There would be no impact to protected marine vegetation such as mangroves. The mapped Key Fish Habitat of the Georges River is outside of the REF proposal area so no direct impacts to mapped Key Fish Habitat will occur.

Biodiversity offsets

The 'Transport for NSW Guidelines for Biodiversity Offsets' (November 2016) indicates that the following offsets would be required by the REF proposal given residual impacts associated with the current development footprint exceed the predetermined thresholds as specified in the guideline:

- 4.68ha of nationally listed TECs
- 3.51ha of habitat for EPBC Act listed species including Grey-headed Flying-fox, White-throated Needletail and Swift Parrot
- 3.81ha of habitat for BC Act listed species credit (fauna) species Southern Myotis and for ecosystem credit species
- 69 *Callistemon linearifolius* individuals.

A Biodiversity Offset Strategy would be developed during detailed design to identify biodiversity credits and/or supplementary measures for those entities impacted.

The cumulative area of impact on native vegetation that is likely to occur for both the REF proposal area and the EIS proposal area is 1.94ha.

The Biodiversity Offsets Scheme only applies to activities assessed and determined under Part 5 of the EP&A Act if proponents choose to 'opt in' to the Scheme. To satisfy the offset requirements for the proposal, Transport may consider participating in DPIE's Biodiversity Offset Scheme in combination with the offset requirement for the EIS proposal. The BAM calculator has been used to develop an indication of the likely credit offset requirement of the cumulative impacts of the proposal and is summarised in the tables below:

Plant Community Type	Credits required for the REF proposal	Credits required for the EIS proposal	Cumulative total
PCT 725: Broad-leaved Ironbark – <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	7	0	7
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	1	0	1
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	20	1	21
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	2	5	7
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0	1	1

Species	Credits required for the REF proposal	Credits required for the EIS proposal	Cumulative total
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	42	0	42
<i>Myotis macropus</i> (Southern Myotis)	30	8	38

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Glossary of terms

Definitions

Biodiversity Assessment Method	The Biodiversity Assessment Method is established under section 6.7 of the BC Act. The BAM is established for the purpose of assessing certain impacts on threatened species and threatened ecological communities (TECs), and their habitats, and the impact on biodiversity values.
Biodiversity offsets	The gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development (DPIE 2020)
Calculator or BAM-C	Biodiversity Assessment Method Calculator – a tool that applies the BAM to calculate the number and type of credits required to offset the impacts of development on biodiversity or credits generated at a biodiversity stewardship site.
Candidate species	A species has been identified within the assessment area or is considered to have a moderate to high likelihood of occurrence and may be impacted by the REF proposal.
Construction footprint	The area to be directly impacted by the proposal during construction activities (see definition for subject land).
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. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat, and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (the BC Regulation) (DPIE 2020)
Ecosystem credit	A measurement of the value of Threatened Ecological Communities and threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type, and Plant Community Types generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity
EIS proposal	Areas of the overall proposal occurring on land mapped as Coastal Wetlands subject to assessment as designated development under Division 4.1 of the <i>Environmental, Planning and Assessment Act 1979</i> .
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	Impacts that occur when the proposal affects native vegetation and threatened species habitat beyond the development footprint or within retained areas (e.g. transporting weeds or pathogens, dumping rubbish). This includes impacts from activities related to the construction or operational phase of the proposal and prescribed impacts (DPIE 2020).
Local population	Local population: the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions: <ul style="list-style-type: none">• The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend

into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.

- The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
- The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time or return year to year. (OEH 2018)

MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (DPIE 2020).
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality or injury.
Native vegetation	<ol style="list-style-type: none"> trees (including any sapling or shrub or any scrub) understorey plants groundcover (being any type of herbaceous vegetation) plants occurring in a wetland. <p>A plant is native to New South Wales if it was established in New South Wales before European settlement (BC Act).</p>
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Overall proposal	The overall proposal of the Stage 1A upgrade inclusive of all activities impacting areas within the overall proposal boundary.
Population	A group of organisms, all of the same species, occupying a particular area (DPIE 2020).
Proposal area/site/ footprint	The area of land that is directly impacted on by the proposal that is being assessed under the EP&A Act, including access roads, and areas used to store construction materials. It includes the construction and operational areas for the proposal.
REF proposal	The majority of the overall proposal subject to assessment under Division 5.1 of the Environmental, Planning and Assessment Act 1979.
Species credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits (Department of Planning Industry and Environment, 2020a).
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.
Study area	The area directly affected by the REF proposal and any additional areas likely to be affected by the REF proposal, either directly or indirectly. See also definition of local population.
Target species	A species has been identified within the study area or is considered to have a moderate to high likelihood of occurrence and may be impacted by the REF proposal.
Vegetation Integrity Score	The condition of native vegetation assessed for each vegetation zone against the benchmark for the Plant Community Type. A score is generated for each vegetation zone using the Biodiversity Assessment Method Calculator.

Abbreviations

AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method (DIPE 2020)
BAR	Biodiversity Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016</i>
BC Regulation	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme under the BC Act
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CSSI	Critical State Significant Infrastructure
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DIWA	Directory of Important Wetlands in Australia
DoEE	Former Commonwealth Department of Environment and Energy
DPI	NSW Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered ecological community
EES	Environment Energy and Science Group, Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
Environment Agency Head	Environment Agency Head, Environment, Energy and Science Group, Department of Planning, Industry and Environment
EP&A Act	<i>Environment Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth).
Fisheries NSW Policy and Guidelines	Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
LGA	Local Government Area
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
NSW	New South Wales
NPWS	NSW National Parks and Wildlife Service
OEH	Former NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	EPBC Act Protected Matters Search Tool
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SAIL	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development

SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
Transport	Transport for NSW
VI	Vegetation Integrity
VIS	Vegetation information system

1 Introduction

1.1 Overall proposal background

Transport for NSW (Transport) is proposing to upgrade Henry Lawson Drive between Keys Parade, Milperra, to Tower Road, Bankstown Aerodrome (known as Henry Lawson Drive Upgrade Stage 1A) (the overall proposal). The proposal consists of upgrading a 1.3 kilometre length of Henry Lawson Drive and an additional 480 metres along Milperra Road, including intersections upgrades.

1.2 The overall proposal

The overall proposal forms the first stage of the progressive upgrade to 7.5 kilometres of Henry Lawson Drive between the intersections of Hume Highway, Villawood, and the M5 South Western Motorway, Milperra (Figure 1.1).

The upgrade would help ease existing traffic issues and increase traffic capacity at key intersections to help meet growing demand, with residential, commercial and industrial development in the surrounding area expected to increase in the coming years. The upgrade would be delivered in three stages.

Subject to approval, construction of the Stage 1A proposal may commence in early 2023 and would take about two years to complete. Other stages of upgrading Henry Lawson Drive would be developed and assessed separately in the future.

The REF proposal incorporates the majority of the overall proposal, however excludes works which are located within the SEPP (Coastal Management) area (Figure 1.1 and Figure 1.2). These areas have been assessed as part of the EIS that has been prepared in parallel with this REF. This Biodiversity Assessment Report focusses on the REF proposal. A separate report, Biodiversity Development Assessment Report, focusses on the EIS proposal.

Key features of the REF proposal would include:

- widening Henry Lawson Drive from two to four lanes
- upgrading the signalised intersection of Henry Lawson Drive and Tower Road including:
 - an additional right turn lane from Tower Road onto Henry Lawson Drive
 - a new channelised short left-turn lane from Henry Lawson Drive (southbound) onto Tower Road
 - an additional right turn lane from Henry Lawson Drive (northbound) onto Tower Road
 - retaining the pedestrian crossing across Henry Lawson Drive on the southern side of the intersection
- upgrading the signalised intersection of Henry Lawson Drive and Milperra Road/ Newbridge Road including:
 - an additional right turn lane on the Milperra Road and Newbridge Road approaches to Henry Lawson Drive
 - an additional through lane on the Henry Lawson Drive southbound approach
 - an additional right turn lane on Henry Lawson Drive northbound approach
- removing the dedicated left turn slip lane into the ALDI and fast food area with access being retained via a standard property driveway
- retaining the existing bus stop on Milperra Road (eastbound) and moving the westbound bus stop 20 metres to the west
- altering access to Auld Avenue to a “left in/left out” only configuration
- installing a new Henry Lawson Drive road bridge over the Milperra Drain to the south of Auld Avenue (referred to the Auld Avenue bridge) to carry northbound traffic and retaining the existing bridge for southbound traffic

- constructing new footpaths on the eastern side of Henry Lawson Drive to connect Tower Road to the existing bus stop on the eastbound lanes of Milperra Road and a new footpath on the southern side between Henry Lawson Drive to the bus stop on the westbound lanes of Milperra Road
- widening the shared user pathway between Flower Power (Keys Parade) and Newbridge Road to three metres and reconstructing footpaths along the western side of Henry Lawson Drive, where required
- adjusting drainage including lengthening culverts, installing new drainage infrastructure and water quality controls
- relocating utilities (including electrical, gas, water and telecommunications)
- final roadworks including pavement, kerb and gutters, signs, lighting and line marking
- ancillary work for the proposal including, but not limited to road furniture, tie-in works, landscaping, earthworks and the like
- temporary ancillary compounds, stockpile sites and associated facilities.

The overall proposal forms Stage 1A of the progressive upgrade of Henry Lawson Drive between the Hume Highway, Villawood, and the M5 South Western Motorway, Milperra. Subject to approval, construction of the Stage 1A proposal may commence in early 2023 and would take about two years to complete. Other stages of upgrading Henry Lawson Drive would be developed separately in the future and will be subject to a separate assessment process.

1.3 Study area

The REF proposal is in the south-western Sydney region, located about 24 kilometres south-west of the central business district of Sydney, in the Bankstown local government area (LGA). The study area occurs in the suburbs of Bankstown Aerodrome and Milperra.

The study area covers a length of about 1.3 kilometres of Henry Lawson Drive between Tower Road (located north of Milperra Road) and Keys Parade, and includes about a 1 kilometre section of Milperra Road between the intersection with Henry Lawson Drive and Ashford Avenue (Figure 1.1).

The following areas are discussed throughout the Biodiversity Assessment Report (BAR) and are defined as:

- REF proposal area footprint: the footprint of the REF proposal is the environmental assessment construction footprint for the REF proposal (REF proposal area footprint is illustrated in Figure 1.2) and excludes the EIS proposal areas. The footprint has been defined by Transport's concept design for the Stage 1A proposal and is indicative. It is expected that the footprint would be refined during the next stage of detailed design.
- Study area: includes the REF proposal area footprint and adjacent areas of vegetation and associated habitat surveyed as part of this investigation which may be subject to direct or indirect impacts as a result of the REF proposal (study area is illustrated in Figure 1.1).
- Locality: This is taken to be a 10-kilometre radius surrounding the REF proposal footprint.
- Bioregion: The study area is located in the Sydney Basin bioregion (Cumberland subregion) (Department of the Environment and Energy, 2016).

Figure 1.1
Proposal overview

Legend

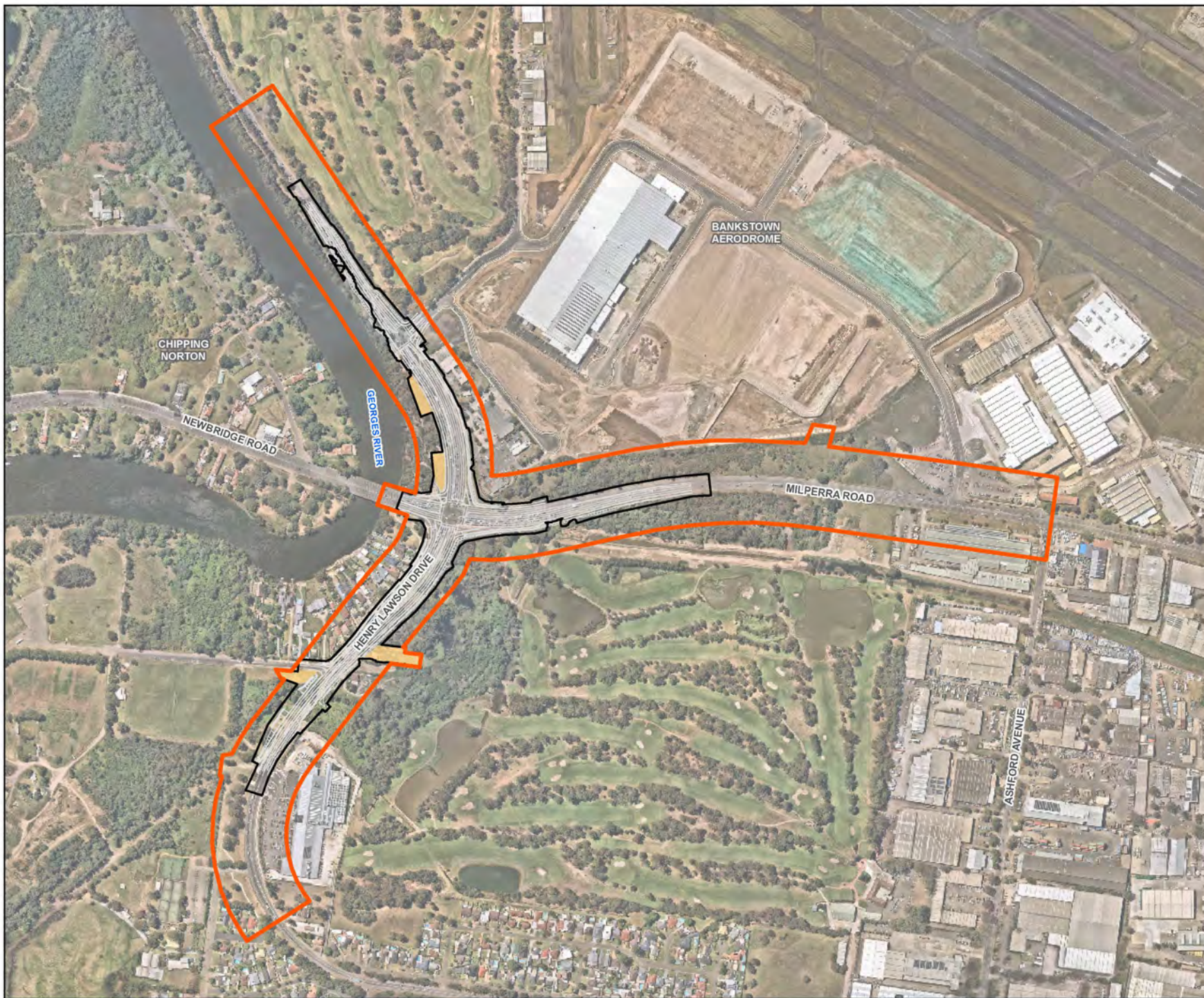
- Watercourse
- Study area
- EIS proposal area
- REF proposal area
- Potential compound sites



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 07-May-21
 Data sources: NEARMap, NSW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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Figure 1.2
The proposal



Legend

- Concept Design
- REF proposal area
- Potential compound sites



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 07-May-21
 Data sources - NEARMap, NSW, Geoscience Australia
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1.4 Report objectives

The objectives of this report are to:

- inform the development of the REF proposal's design
- identify and evaluate the potential impacts on biodiversity of the REF proposal's concept design that forms the REF proposal.
- inform the REF being prepared for the proposal to fulfil the requirements of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act)
- take into account all matters affecting or likely to affect terrestrial and aquatic biodiversity as a result of the REF proposal
- identify any likely biodiversity offset obligations in accordance with the Biodiversity Offset Guidelines (RMS 2016).

This report identifies and assesses the likely impacts to species, populations and communities listed as threatened under the *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.5 Legislative context

A Review of Environmental Factors (REF) has been prepared to satisfy Transport duties under s5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to “examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity” and s.5.5 in making decisions on the likely significance of any environmental impacts. This BAR forms part of the REF being prepared for the REF proposal and assesses the biodiversity impacts of the REF proposal to meet the requirements of the EP&A Act.

Sections 7.3 of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and endangered ecological communities is assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General's requirements or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

In September 2015, a “strategic assessment” approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Transport activities being assessed under Part 5 Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Transport for NSW proposals assessed via an REF:

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

Transport must consider impacts to nationally listed threatened species, ecological communities and migratory species as part of the approval process under the strategic assessment. To assist with this, assessments are required in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment 2013).

2 Methods

2.1 Personnel

This BAR has been prepared by a team of qualified and experienced ecologists and accredited BAM assessors (see Table 2.1).

Table 2.1 Personnel

Name	Role	Qualifications
Alex Cockerill	Ecology National Team Executive – Project director	Bachelor of Science (Hons), BAM Accredited Assessor (BAAS17020)
Toby Lambert	Principal Ecologist – Project manager and technical review	Bachelor of Environmental Science, BAM Accredited Assessor (BAAS17046)
Mark Stables	Principal Ecologist – Field survey and report preparation	Bachelor of Science (Hons), BAM Accredited Assessor (BAAS18097)
Lukas Clews	Principal Ecologist – Field surveys and report preparation	Master of Scientific Studies, Graduate Certificate in Applied Science, Diploma Conservation and Land Management, Bachelor of Science, BAM Accredited Assessor (BAAS17060)
Debbie Landenberger	Principal Ecologist – Report preparation	Bachelor of Science (Hons), BAM Accredited Assessor (BASS18187)
Josie Stokes	Principal Ecologist – Report preparation	Bachelor of Science (Conservation Zoology)
Tanya Bangel	Senior Ecologist – Field survey and report preparation	Bachelor of Environmental Management and Science (Hons), Diploma of Conservation and Land Management, BAM Accredited Assessor (BAAS18076)
Allan Richardson	Senior Ecologist – Field survey and report preparation	Bachelor of Environmental Science (Hons) and has completed the BAM training
Troy Jennings	Ecologist – Field survey	Bachelor of Biodiversity and Conservation, Masters of Wildlife Management, BAM Accredited Assessor (BAAS18172)
Julia Emerson	Ecologist – Field survey	Bachelor of Science, Certificate III Conservation and Land Management, BAM Accredited Assessor (BAAS18034)
Clementine Watson	Ecologist – Field survey	Bachelor of Environmental Science, BAM Accredited Assessor (BAAS18164)
Devon Raiff	Graduate Ecologist – Field survey and reporting	Bachelor of Science, Certificate III Land Management and Conservation
Emily Mitchell	Mapping and data management – GIS operator	Masters of Information Technology, Bachelor of Development Studies, Certificate IV Spatial Information Services
Huw Chittleborough	Mapping and data management – GIS operator	Bachelor of Applied Geographical Information Systems (Hons)
Nichole Kelleway	Mapping and data management – GIS operator	Diploma of Agriculture, Precision Agriculture, Bachelor of Spatial Science and Technology (GIS)

2.2 Nomenclature

Names of vegetation communities used in this report are based on the PCT used in the NSW BioNet Vegetation Classification Database (Environment Energy and Science, 2021c). These names are cross-referenced with those used for threatened ecological communities listed under the BC Act and/or the EPBC Act.

Names of plants used in this document follow PlantNet (Royal Botanic Gardens, 2021). Scientific names are used in this report for species of plant. The names of introduced species are denoted with an asterisk (*).

For threatened species of plants, the names used in the BioNet Atlas of NSW Wildlife (Environment Energy and Science, 2021b) are also provided where these differ from the names used in the PlantNet database.

Names of vertebrate fauna follow the Australian Faunal Directory maintained by the DAWE (2021a). Common names are used in the report for species of animal. Both common and scientific names are provided in appendices.

For threatened species of animals, the names used in the BioNet Atlas of NSW Wildlife and DPI Spatial Data Portal (2021) are provided.

2.3 Sources of information used in this assessment

The following information sources were used to inform the preparation of this report:

- aerial photographic imagery
- NSW Mitchell Landscapes (Department of Planning Industry and Environment, 2021b)
- Interim Biogeographic Regionalisation of Australia (IBRA version 7.0) (Department of the Environment and Energy, 2016)
- Atlas of Groundwater Dependent Ecosystems (GDE) (Bureau of Meteorology, 2021)
- Directory of Important Wetlands of Australia (Department of Agriculture Water and the Energy, 2021b)
- Register of Declared Areas of Outstanding Biodiversity Value (AOBV) – Critical habitat declarations in NSW (Department of Planning Industry and Environment, 2021a)
- Register of Critical Habitat (Department of Agriculture Water and the Energy, 2021d)
- The Native Vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage, 2016)
- NSW BioNet Threatened Biodiversity Data Collection (Environment Energy and Science, 2021d)
- BioNet Atlas of NSW Wildlife (Environment Energy and Science, 2021b)
- BioNet Vegetation Classification Database (Environment Energy and Science, 2021c)
- EPBC Act Protected Matters Search Tool (Department of Agriculture Water and the Energy, 2021c)
- Species Profiles and Threats Database (Department of Agriculture Water and the Energy, 2021e)
- NSW Flora Online (PlantNet) (Royal Botanic Gardens, 2021)
- Atlas of Living Australia – interactive map search (Atlas of Living Australia, 2021).
- other relevant documents and data that were reviewed as part of this study are referenced throughout this report where appropriate.

Other relevant documents and data that were reviewed as part of this study are referenced throughout this report where appropriate.

2.4 Background research

Background research was conducted to identify:

- the likely distribution of vegetation communities, based on previous mapping and aerial photograph interpretation, for targeted field verification
- a list of candidate threatened species and populations of plants to target during vegetation surveys and habitat assessment
- a list of candidate threatened species and populations of animals and migratory animals to consider during field-based habitat assessment
- local landscape-scale features of potential significance to biodiversity; e.g. riparian zones and potential wildlife movement corridors
- evaluate baseline information and determine whether additional surveys, mapping and reporting is required to support development approval.

The background research included analysis of the following information sources:

- topographic map and aerial photographs
- Atlas of Groundwater Dependent Ecosystems (GDE) (Australian Bureau of Meteorology 2017)
- SEPP Coastal Management 2018 – Coastal Wetlands
- Directory of Important Wetlands of Australia (DIWA)
- Priority weed listings for the Greater Sydney region (Department of Primary Industries 2018)
- Native vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands (Tozer, Turner et al. 2010)
- The Native Vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage 2016).
- Henry Lawson Drive, Hume Highway to M5: Preliminary Environmental Investigation (GHD 2014)
- Bankstown City Council – Community Land Generic Plan of Management (Bankstown City Council 2015)
- Bushland Plan of Management – Reserves in immediate vicinity of Bankstown Airport (includes Kentucky Reserve, Airport Reserve, Ashford Reserve & Bushland on the corner Henry Lawson Drive & Milperra Road (Bankstown City Council 2004).
- Lansdowne Reserve Survey of Remnant Vegetation (Gibson & Miller 1997)
- Mirambeena Regional Park Flora Survey (Gibson & Miller 1997)
- Flora and Fauna Assessment for a proposed entrance driveway from Milperra Road, Milperra, through reserve area Lot 292 in DP 41530 to the Bankstown Airport Precinct (Actinotus Environmental Consultants 2011).

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

Table 2.2 Database searches undertaken

Database	Search date	Area searched	Reference
Bionet Atlas of NSW Wildlife	03/03/2021	10km buffer around the study area	Environment, Energy and Science Group (2020a)
PlantNet	03/03/2021	LGA spatial search	Royal Botanic Gardens Sydney (2020)
BAM calculator	04/03/2021	Search of candidate and predicted species using BAM data from vegetation within the subject land	EES group (2020)
Areas of outstanding biodiversity value	03/03/2021	Search of register	EES Group (2020)
NSW Department of Primary Industries Fisheries Fish Records Viewer	03/03/2021	Spatial search of study area/subject land	Department of Primary Industries (2020)
NSW Department of Primary Industries (Fisheries) critical habitat	03/03/2021	Search of register	Department of Primary Industries (2020)
Atlas of Groundwater Dependant Ecosystems	03/03/2021	Spatial search of study area/subject land	Bureau of Meteorology (2020)
Directory of Important Wetlands	03/03/2021	Spatial search of study area/subject land	Department of Agriculture, Water and Environment (2020)
Commonwealth Protected Matters Search Tool	03/03/2021	10km search area centred on study area/subject land	Department of Agriculture, Water and Environment (2020)

Other relevant documents and data that were reviewed as part of this study are referenced throughout this report where appropriate.

2.4.1 Aquatic biodiversity background review

There is sufficient existing information available on the Georges River and tributaries to describe the existing aquatic environment and to assess the quality and importance of the aquatic environments that will be potentially impacted so detailed aquatic ecology field surveys over and above a habitat assessment were not deemed necessary. Searches of databases and mapping tools were used to identify aquatic biodiversity values. The sources reviewed included:

- Fisheries Spatial Data Portal (freshwater threatened species maps)
- NSW DPI Fish communities and threatened species distribution of NSW (DPI, 2016)
- NSW DPI Listed threatened species, populations and ecological communities website
- NSW Aquatic Pest and Disease Distribution website
- NSW DPI Critical habitat register
- NSW DPI Key Fish Habitat mapping
- Protected Matters Search Tool
- Atlas of Living Australia (ALA)
- State Environmental Planning Policy (Coastal Management) 2018 Coastal Wetland mapping.

2.5 Habitat assessment

A habitat assessment was undertaken within the study area on the identified list of threatened flora and fauna species known or predicted to occur within a 10-kilometre radius of the REF proposal (see Appendix B for the habitat assessment results). This list was identified from databases and literature as well as past surveys. The habitat 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. candidate threatened species). The habitat assessment formed the basis for targeted surveys within the study area.

The criteria used in the habitat assessment are detailed in Table 2.3. The results of the habitat assessment are provided in Appendix B.

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) 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). 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.

2.6 Field survey

The field survey aimed to ground truth the results of the background research and habitat assessment. As such, all threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence. A description of all field surveys completed to inform this report is provided below.

2.6.1 Weather conditions

Original field surveys

Initial native vegetation surveys were undertaken by WSP (2019) over an eight-day period on the 21 to 25 & 31 May, 1 & 21 of June 2018. Additional field surveys were undertaken on the 6 & 7 April, and the 29 & 30 September and 1 October 2020. All proposed field surveys were rescheduled for and organised for April in consultation with Transport due to health and safety concerns surrounding Covid-19, and uncertainty about whether complete lockdowns would occur and for how long. If the initial additional field surveys had not been fast-tracked there was the potential threat that surveys could not be completed as required due to Covid-19 issues.

Additional field surveys

Additional flora and fauna field surveys sought to verify existing mapping (WSP, 2019) and survey additional areas within the study area/subject land as well as supplement previous surveys. These surveys were completed on 6 & 7 April, 29 & 30 September and 1 October 2020. The focus of these surveys was to fulfill any requirements of the BAM within the subject land (including additional BAM Vegetation Integrity plots) as well as ground-truth the results of the background research, habitat suitability assessments, presence of threatened species and breeding habitat features for candidate threatened fauna.

Weather conditions

Weather conditions can affect activity (and therefore detectability) of some species. If adverse weather conditions occur during field surveys the validity of survey techniques are affected and can impact the probability of detecting a species if it was present within the study area. During the field survey program weather conditions were generally mild with low to moderate winds and temperatures recorded. Low amounts of rainfall were received during the survey program. These conditions were somewhat favourable and are outlined in Table 2.4.

Table 2.4 Weather conditions during the survey period

Date	Temp. min.	Temp. max.	Wind direction (km/hr)	Rain (mm)
21/05/2018	6.1	22.5	W 25	0
22/05/2018	6.0	24.1	W 37	0
23/05/2018	10.4	22.6	NE 22	0
24/05/2018	6.9	20.7	SE 33	0
25/05/2018	13.5	20.9	ESE 28	0
31/05/2018	5.9	19.0	SSW 46	1.2
01/06/2018	8.4	18.3	SSE 54	0
21/06/2018	10.6	18.0	E 17	0.6
04/12/2018	16.5	24.7	SE 46	0
05/12/2018	16.3	22.0	SE 24	1.0
12/12/2018	16.7	25.8	ENE 30	0
13/12/2018	19.5	29.1	W 72	2.4
06/04/2020	10.6	24.3	SE 37	0
07/04/2020	15.3	21.7	SE 30	0
29/09/2020	9.7	20.2	NNE 33	0
30/09/2020	8.9	21.9	NNE 31	0
01/10/2020	13.4	25.5	SE 41	1.4

Note: Sources from Bankstown AWS (066137)

2.6.2 Vegetation surveys

Initial native vegetation surveys were undertaken by WSP (2019) over an eight-day period on the 21 to 25 & 31 May, 1 & 21 of June 2018. Additional field surveys were undertaken on the 6 & 7 April, 29 & 30 September and 1 October 2020. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitat, especially for threatened species, populations and ecological communities.

The field surveys aimed to ground truth the results of the background research including desktop analysis of vegetation and habitat assessment. The floristic diversity and possible presence of threatened species was assessed using a combination of survey techniques including; plot-based (quadrat/transect), rapid point assessments and parallel line transverses in accordance with the relevant guidelines.

Verification of existing vegetation mapping

Preliminary mapping of vegetation community boundaries was undertaken through analysis of existing vegetation mapping and aerial photograph interpretation.

Analysis of the aerial photographs was used to identify areas of disturbance (e.g. buildings, vehicle tracks, dams and power lines), vegetation structure and likely native versus exotic species composition throughout the site. This provided an initial definition of vegetation communities into simple structural and disturbance classifications for verification during field surveys.

Vegetation within the study area and locality has been mapped at the regional scale in:

- Native vegetation of the Southeast NSW: Revised Classification and Map for the Coast and Eastern Tablelands (Tozer, Turner et al. 2010)
- The Native Vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage 2016).

Data on geology, dominant canopy species, native diversity, vegetation structure and condition was collected across the study area to validate and refine this existing vegetation classification to determine their associated Plant Community Type (PCT) in accordance with the BioNet Vegetation Classification (Environment Energy and Science, 2021c).

Condition of vegetation

Field validation (ground-truthing) of the existing vegetation classifications undertaken by regional vegetation mapping and previous ecological surveys of the site was completed to confirm the vegetation structure, dominant canopy species, native diversity, condition and presence of threatened ecological communities. This was based on vegetation integrity plot data collected as described below.

Vegetation zones and conditions were identified and mapped following the BAM (Department of Planning Industry and Environment, 2020a). This was based on field verification of the PCT, class and formation as outlined in BioNet Vegetation Classification (Environment Energy and Science, 2021c). Criteria used to assign vegetation zones based on broad vegetation condition class classification are outlined in Table 2.5.

Table 2.5 Vegetation broad condition states

Condition classes	Description criteria
High	Vegetation still retains the species complement and structural characteristics. The vegetation displays resilience to weed invasion due to intact groundcover, shrub and canopy layers. Native species diversity is relatively high. Weeds may exist in this vegetation type but exhibit <10% foliage cover. High condition vegetation is considered to exhibit a vegetation integrity score of >70.
Moderate	Vegetation has retained a native canopy, but the understorey and groundcover layers are generally co-dominated by exotic species. The mid and low strata may have been structurally modified because of previous disturbance and subsequent weed incursions. Moderate condition vegetation is considered to exhibit a vegetation integrity score of between 40 and 70.
Poor	Vegetation has retained a native canopy, or the canopy cover is showing signs of regeneration. The understorey and groundcover layers are generally dominated or co-dominated by exotic species. Native species diversity is generally relatively low, and the mid and low strata have been structurally modified due to weed incursions or clearing. Poor condition vegetation is considered to exhibit a vegetation integrity score of <40 and does not meet low condition thresholds as described below.
Low	Vegetation is in low condition where: <ul style="list-style-type: none"> • a vegetation zone has a vegetation integrity score <15 where the PCT is representative of an endangered or critically endangered ecological community • a vegetation zone has a vegetation integrity score <17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community • a vegetation zone has a vegetation integrity score <20 where the PCT is not representative of a TEC or associated threatened species habitat.

Plot and transect survey

Vegetation integrity plots (VI plots) were completed in accordance with BAM. A schematic diagram illustrating the layout of each vegetation integrity plot is provided in Figure 2.1.



Figure 2.1 Vegetation integrity plot layout

The following site attributes were recorded at each vegetation integrity plot location:

- **Location:** (easting – northing grid type MGA 94, Zone 56).
- **Vegetation structure and dominant species and vegetation condition:** Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer.
- **Native and exotic species richness (within a 400-metre squared quadrat):** This consisted of recording all species by systematically walking through each 20-metre x 20-metre plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded.
- **Number of trees with hollows (1000 metre squared quadrat):** This was the frequency of hollows within living and dead trees within each 50-metre x 20-metre plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least five centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least one metre above the ground and the (e) the centre of the tree was located within the sampled quadrat.
- **Number of large trees and stem size diversity (1000 metre squared quadrat):** tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of all living trees (greater than five-centimetre DBH) within each 50 metre x 20 metre plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks.
- **Total length of fallen logs (1000 metre squared quadrat):** This was the cumulative total of logs within each 50-metre x 20 metre plot with a diameter of at least 10 centimetres and a length of at least 0.5 metre.
- **Litter cover:** This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 centimetre which is detached from a living plant) from within five 1 metre x 1 metre sub-plots spaced evenly either side of the 50-metre central transect.
- **Evaluation of regeneration:** This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height less than or equal to five centimetres).

Prior to establishing plot survey locations, vegetation stratification was undertaken to provide a representative vegetation zone for sampling. Stratification involved marking waypoints and bearings randomly to provide a representative assessment of the vegetation integrity of the vegetation zone in the study area and establishing the required number of plots at some of these waypoints.

Areas of non-native vegetation were also identified and mapped. Data was collected in these areas through rapid point assessments to show the composition and abundance of non-native vegetation within the study area.

A comparison of the number of BAM VI plots that were completed and the required BAM plots per vegetation zones are outlined in Table 2.6. Table 2.7 outlines the Plot ID, PCT and vegetation zone, and location of each BAM VI plot that was completed during the survey.

Table 2.6 Vegetation survey effort

Plant community type	Vegetation zone	Area in study area (ha)	Minimum number of VI Plots required (BAM 2020)	Survey effort
VZ1 PCT 725 – Broad-leaved Ironbark – <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – moderate condition	Moderate	2.33	2	Q1, Q3
VZ1a PCT 725 – Broad-leaved Ironbark – <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – poor condition	Poor condition (regrowth)	0.60	1	Q4
VZ2 PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition	Moderate condition	0.21	1	Q23
VZ3 PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition	Moderate condition – Forest Red Gum variant	2.32	2	Q12, Q18, Q24
VZ4 PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition	Moderate condition - Blue Box variant	0.64	1	Q7 ¹
VZ9 PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Moderate condition	Moderate condition	0.29	1	Q25
VZ11 PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition	Poor condition	0.84	1	Q2
VZ12 PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition	Moderate condition	1.32	1	Q21
VZ13 PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley – Poor condition	Poor condition	0.90	1	Q20, Q26
VZ14 Miscellaneous ecosystem – Urban exotic/native landscape plantings	–	0.30	0	–
VZ15 Miscellaneous ecosystem – Weeds/exotics – non-native vegetation	–	8.94	0	Q19
Miscellaneous ecosystems – Waterbodies	–	1.27	0	–

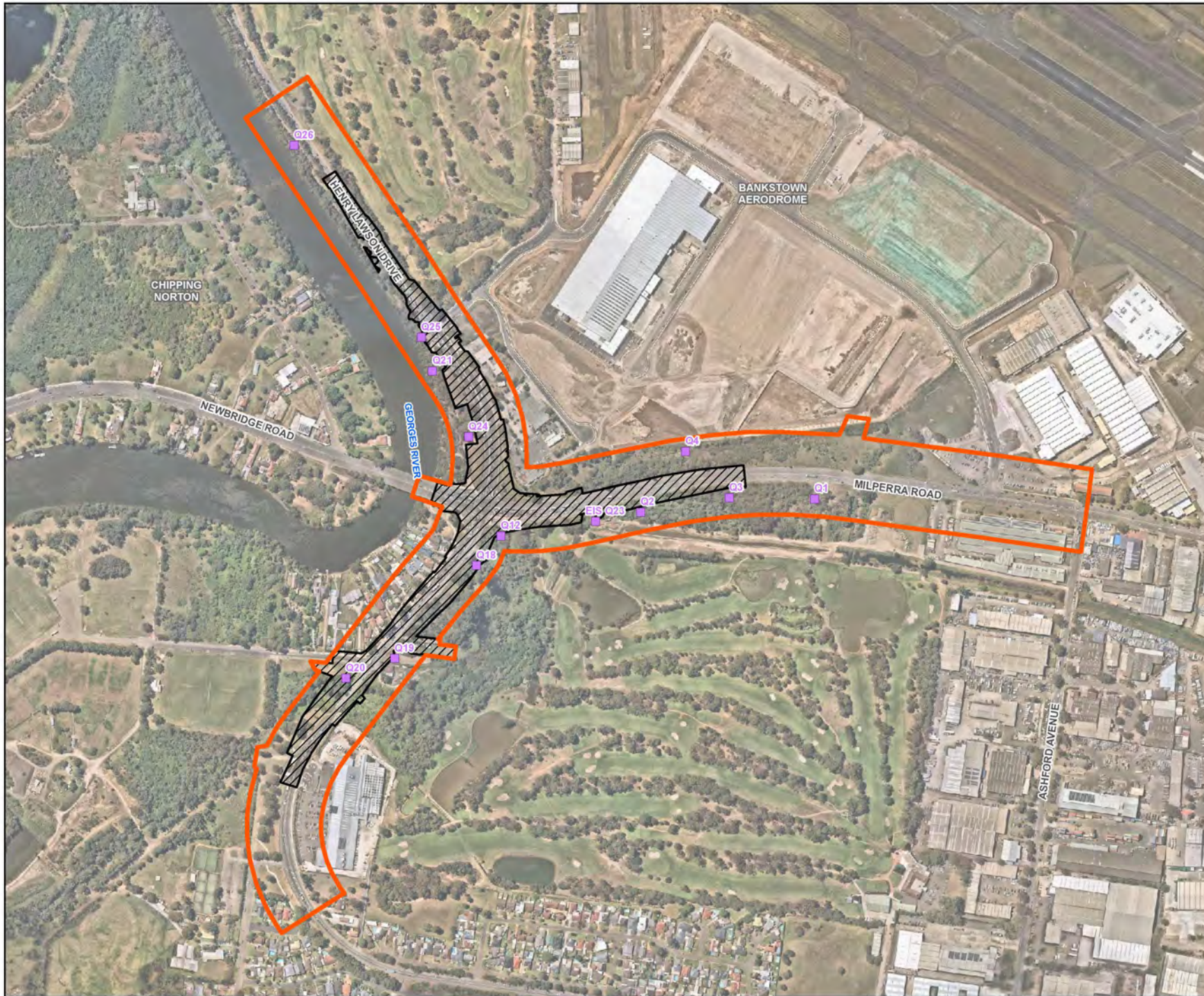
1. Q7 has been taken from WSP (2018) – Stage 2 works due to lack of suitable patch size for a plot in Stage 1A. Plot was completed in accordance with BAM 2017 methodology.

Table 2.7 BAM VI plots completed within the study area

Plot ID	Vegetation type and zone	Easting ²	Northing ²	Orientation
Q1	VZ1 – PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition	313855	6243825	260
Q2	VZ11 – PCT 1236: Swamp Paperbark – Swam Pak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Croner Bioregion – Poor condition	313573	6243803	270
Q3	VZ1 – PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition	313716	6243827	280
Q4	VZ1a – PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition (regrowth)	313645	6243901	280
Q7 ¹	VZ4 – PCT 835: Forest Red Gum Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)	312766	6245100	168
Q12	VZ3 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	313346	6243765	90
Q18	VZ3 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	313306	6243717	320
Q19	VZ15 Miscellaneous ecosystem – Weeds/exotics – non-native vegetation	313174	6243566	70
Q20	VZ13 – PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition	313095	6243534	250
Q21	VZ12 – PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition	313235	6244032	20
Q23	VZ2 - PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition	313565	6243824	0
Q24	VZ3 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	313291	6243933	315
Q25	VZ9 – PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Good condition	313217	6244086	310
Q26	VZ13 – PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition	313011	6244397	139

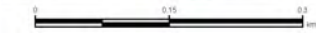
1. Q7 has been taken from WSP (2018) – Stage 2 works due to lack of suitable patch size for a plot in Stage 1A. Plot was completed in accordance with BAM 2017 methodology.
2. Coordinates in Zone 56, GDA94

Figure 2.2
Vegetation survey locations



Legend

- Quadrats
- Study area
- REF proposal area



Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:6,000 Date: 12/05/21

Data sources - NEARMap, TNSW, Geoscience Australia, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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2.6.3 Targeted flora surveys

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence (Appendix B). Targeted flora surveys were completed by conducting reference checks, parallel line traverses, random meanders and during BAM VI plot surveys. A summary of the targeted flora surveys completed is outlined below with a comprehensive overview provided in Table 2.8.

Vegetation integrity plots

Plot and transect surveys were carried out in accordance with the BAM (Office of Environment & Heritage, 2017). At each plot and transect survey location, dedicated 20-minute searches were conducted for threatened species assessed as having a moderate or high likelihood of occurrence within each vegetation type sampled. The number of plots completed for each identified vegetation zone is provided in Table 2.6 with the location of each transect/plot identified in Table 2.7 and Figure 2.2.

Parallel line traverses

Targeted flora surveys in the form of parallel line traverses were used to search for threatened species assessed as having a moderate or high likelihood of occurrence within the high condition vegetation within the study area. This involved two ecologists searching along parallel transverses (20m width) across potential habitat for each threatened species. This methodology is consistent with the current guidelines for NSW threatened plant surveys (Office of Environment & Heritage, 2016).

Random meander

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random meander throughout the study area recording dominant and key plant species (e.g. threatened species, priority weeds), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Random meander surveys were conducted to locate candidate threatened species and populations within area of suitable habitat. Where a threatened flora species was located, parallel field traverses were then conducted to determine the size and extent of the population.

2.6.4 Targeted fauna surveys

Targeted threatened fauna surveys were undertaken over a five-day period between the 21 to 25 May 2018 and a four-day period of 4-5 and 12-13 December 2018. Opportunistic surveys were carried out over a further three days on 31 May, 1 & 21 of June 2018. Additional field survey was undertaken on the 6 & 7 of April, 29 -30 September and 1 October 2020.

Targeted fauna surveys were undertaken in accordance with the following guidelines:

- Cumberland Plain Land Snail – Environmental Impact Assessment Guidelines for Cumberland Land Snail (*Meridolum corneovirens*) (National Parks and Wildlife Service, 2000)
- SAT – method endorsed by the Australian Koala Foundation, recognised industry standard that is useful for determining presence/absence and habitat preference of Koala
- Survey Guidelines for Australia's Threatened Bats (Department of Environment Water Heritage and the Arts, 2010a)
- Survey Guidelines for Australia's Threatened Birds (Department of Environment Water Heritage and the Arts, 2010b)
- Survey Guidelines for Australia's Threatened Frogs (Department of the Environment Water Heritage and the Arts, 2010)

- Survey Guidelines for Australia's Threatened Mammals Commonwealth of Australia (Department of Environment Water Heritage and the Arts, 2011)
- Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (Department of Environment and Climate Change, 2009a).

Survey effort undertaken for threatened fauna species for the REF proposal are summarised in Table 2.9 and illustrated on Figure 2.3.

Nocturnal surveys

Nocturnal surveys consisted of spotlighting and call playback, targeting threatened owls, threatened arboreal mammals and threatened amphibians.

Spotlighting was used to target arboreal, flying and ground-dwelling mammals, as well as, nocturnal birds and amphibians. Spotlighting was completed after dusk (May 2018 & December 2018). Surveys were completed on foot using high-powered headlamps and hand torches. Sighted animals were identified to the species level.

Call playback was used to survey for nocturnal birds, arboreal mammals and amphibians (e.g. Powerful Owl, Squirrel Glider, Koala & Green and Golden Bell Frog), using standard methods (Debus, 1994, Debus and Chafer, 1994, Debus and Rose, 1994). Call playback was completed after dusk at numerous locations.

For each survey, an initial listening period of 10 to 15 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animals in the immediate vicinity. The calls of the target species were then played intermittently for five minutes followed by a 10-minute listening period. After the calls were played, another 10 minutes of spotlighting was done in the vicinity to check for animals attracted by the calls, but not vocalising. Calls from Stewart and Pennay (Pennay et al., 2004, Stewart, 1998) were broadcast using a portable media player and megaphone.

Diurnal bird surveys

Formal 20-minute diurnal bird searches were completed within the study area/subject land. Bird surveys were completed by actively walking through the nominated site (transect) over a period of 20-minutes (Department of Environment Water Heritage and the Arts, 2010b). All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred during morning hours or evening. Birds were also recorded opportunistically during all other surveys.

Where seasonal conditions for some species including flowering eucalypts were not suitable during the timing of onsite investigations, as was the case for threatened blossom nomads such as the Regent Honeyeater and Swift Parrot, likelihood of occurrence assessments were conducted based on the presence/absence of suitable habitat and its condition. This is a conservative approach that takes into account the presence or absence of suitable habitats to assess a difficult to detect species when survey conditions were not appropriate. Where suitable habitat is present, the species is assumed to occur.

Remote camera

Remote motion sensing infra-red cameras were positioned in the study area/subject land to target arboreal mammals (e.g. Squirrel Glider). Seven remote cameras were used to target threatened arboreal mammals in appropriate microhabitats in the study area/subject land for four consecutive nights in May 2018. Cameras were placed approximately 2 m above the ground aimed at semi-mature or mature flowering native trees or likely foraging habitat. Cameras were also used to target other animals occurring within survey locations including introduced species.

Koala spot assessments

In areas where habitat assessment was undertaken, a Spot Assessment Technique (SAT) was undertaken within the study area/subject land to identify the presence of Koala usage within native vegetation. The SAT identifies whether local Koala tree species preferences by measuring the rate at which each species is utilised by Koalas.

The SAT involves measuring activity within the immediate area surrounding a tree of any species known to have been utilised by Koalas, or otherwise considered to be of some importance for Koala conservation and/or assessment purposes. A minimum of 29 surrounding trees are sampled systematically for Koala faecal pellets for 1 metre around the base of each tree. The activity of Koala usage for each SAT is then expressed as the percentage equivalent of the proportion of the surveyed trees within each SAT. The percentage is then compared to prescribed ranges for activity levels for Koalas within NSW (Phillips and Callaghan, 2011).

Active invertebrate searches

Active invertebrate searches involve diurnal hand searches (i.e. disturbance of habitat) and visual searches targeting specific habitat. In relation to threatened invertebrate species (i.e. Cumberland Plain Land Snail) specific habitat preferences include under logs and other debris, amongst leaf litter and bark accumulations around bases of trees and sometimes in clumps of grass. Invertebrates are also known to shelter under rubbish, disposed building materials and abandoned car parts (National Parks and Wildlife Service, 2000).

Active invertebrate searches were undertaken where habitat assessments were recorded. Surveys were completed by two persons over a 30-minute period with all ground shelter returned to their original position.

Shorebird surveys

A formal 20-minute diurnal bird survey was completed within the study area/subject land where potential shorebird habitat occurred (i.e. tidal areas & mudflats along the Georges River). Shorebird surveys were completed by actively walking through the potential areas (transect) over a period of 20-minutes (Department of Environment Water Heritage and the Arts, 2010b). Surveys were undertaken during summer months (December 2018) when migratory birds are likely to occur within the region and during both low and high tides periods. All birds were identified to the species level, either through direct observation or identification of calls.

Anabats

Ultrasonic Anabat bat detection (Titley Electronics) was used to record and identify the echolocation calls of Insectivorous bats foraging across several native vegetation communities and at potential roosting culverts in the study area/subject land. Passive monitoring of these survey sites was achieved by setting Anabat bat detectors to record from sunset to sunrise within the study area/subject land. Bat call analysis was completed by Nathan Cooper (WSP), with the presentation of data considering the guidelines of the Australasian Bat Society. Bat calls of New South Wales Sydney Basin region (Pennay et al., 2004) was used as a reference collection for bat call identification.

Daytime inspections of culverts and bridges were undertaken within the study area and subject land to identify Insectivorous bats and/or potential roosting sites. This involved searching for roosting bats, signs of microbats presence (chattering, accumulation of scats, staining, flying) and potential roost sites including disused fairy martin nests.

Opportunistic sightings

Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provided indirect information on animal presence and activity.

During these surveys, a hand-held GPS was used to record the locations of:

- hollow-bearing trees
- aquatic habitats
- rock outcrops
- habitat type boundaries.

Fauna habitat assessment

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 within the study area. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species are likely to occur within the study area, if they are not observed during field surveys. Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground cover, including the presence of flowering and fruiting trees representing potential foraging resources
- presence of hollow-bearing trees offering potential roosting and breeding habitat for arboreal mammals, birds and herpetiles
- presence of ground cover vegetation, leaf litter, rock outcrops and fallen timber increasing niche opportunity for ground-dwelling mammals, birds and herpetiles
- presence of waterways (ephemeral or permanent) and water bodies.

Condition of fauna habitat

The following criteria were used to evaluate the condition of habitat values:

- **Good:** A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **Moderate:** Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **Poor:** Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) 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.

Results from fauna habitat assessments were used to inform likelihood of occurrence and habitat suitability assessments following field survey.

2.6.5 Aquatic habitat assessment

The aquatic habitats within the study area were assessed against the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013) and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). The *Aquatic Ecology in Environmental Impact Assessment – EIA Guideline* (Lincoln-Smith, 2003) was used to guide the level of aquatic assessment required.

The condition of the aquatic habitat was assessed using a modified version of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman *et al.*, 1997) (see Appendix B). This assessment involved evaluation and scoring of the characteristics of the adjacent land, the condition of riverbanks, channel and bed of the watercourse and degree of disturbance evident at each site. The maximum score (52) indicates a stream with little or no obvious physical disruption and the lowest score (13) indicates a heavily channelled stream without any riparian vegetation and can be considered to be in poor condition. The RCE score was divided into poor, moderate and good condition categories as follows:

- Poor condition = 13-25
- Moderate condition = 26-39
- Good condition = 39-52.

Ten aquatic habitat assessment sites were surveyed within the study area over the three days on 29 and 30 September and 1 October 2020 (see Figure 2.4).

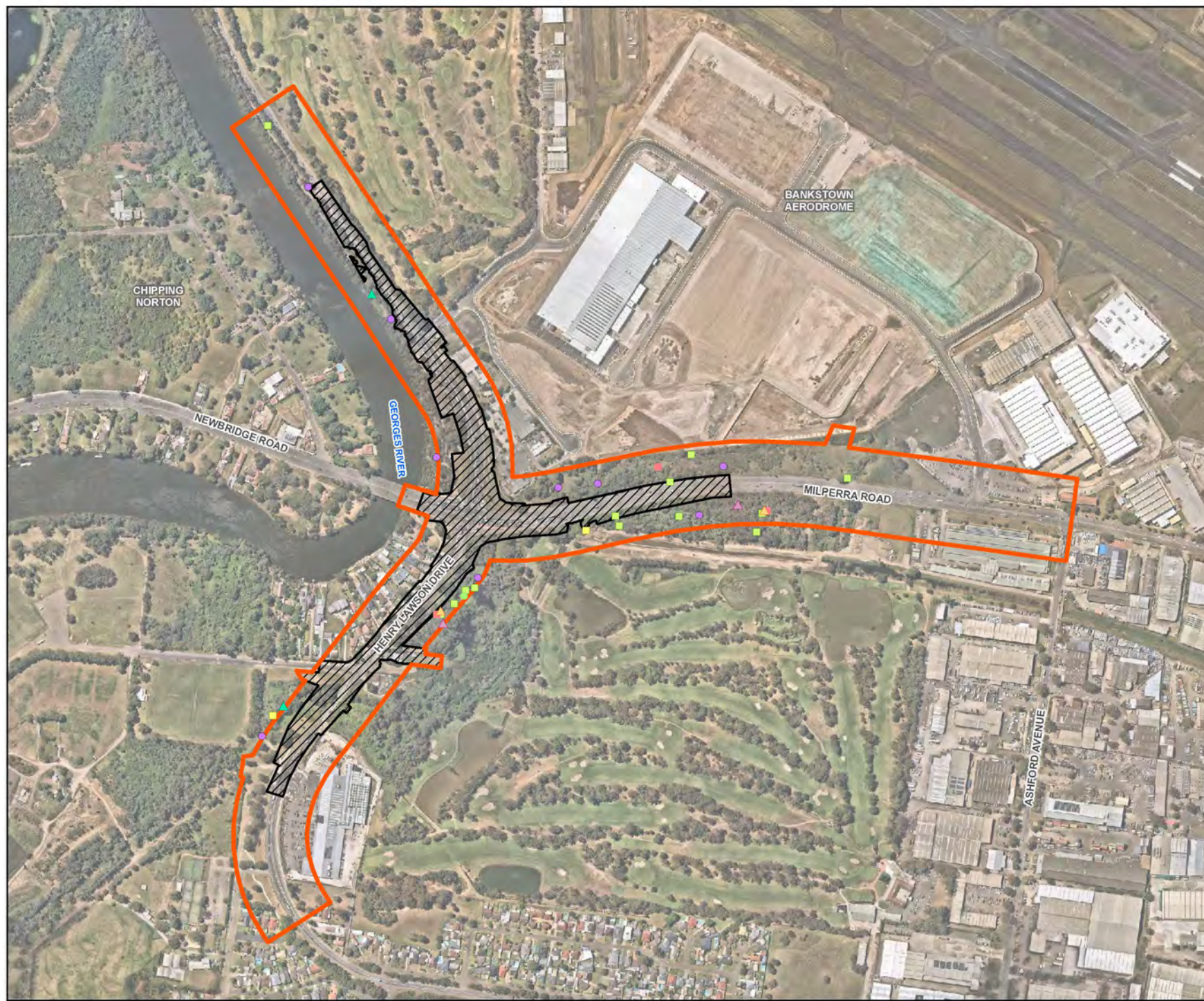
The occurrence of sensitive Key Fish Habitat (KFH) (including the presence of native aquatic macrophytes, large wood debris, large rocks and/or gravel beds) were noted. Surrounding land uses, condition of riparian vegetation, barriers to fish passage (natural or anthropogenic) and the species of macrophytes were noted at each site. The Class and Type of the watercourse at each site was classified according to the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013).

2.6.6 Summary of survey effort

Targeted surveys were completed for threatened flora and fauna species identified as having a moderate to high chance of occurring. Surveys generally adhered to the methods described in the NSW Guide to Surveying Threatened Plants (Office of Environment & Heritage, 2016) and the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft (Department of Environment and Conservation, 2004).

Survey effort undertaken for threatened flora species for the REF proposal is summarised in Table 2.8 with threatened fauna survey effort shown in Table 2.9. The location of threatened fauna survey effort is illustrated on Figure 2.3. All other parts of the study area outside of the point locations were also covered during the survey.

Figure 2.3
Fauna species survey effort



Legend

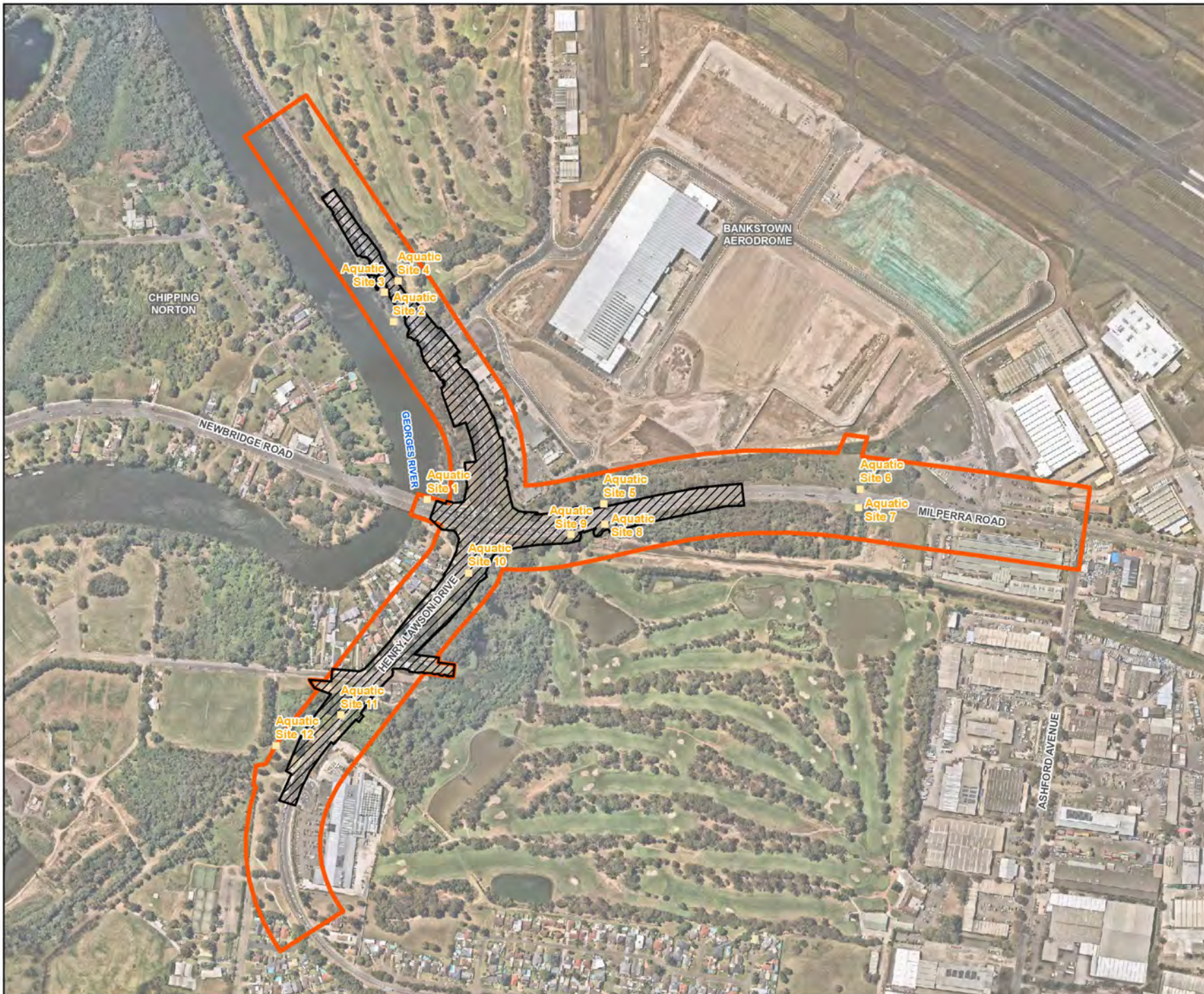
- Study area
- REF proposal area
- Bird survey point
- Call playback point
- Green and Golden Bell Frog Survey
- Habitat
- Microbat survey/Anabat
- Remote cameras
- SAT survey
- Snail search point



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 21/04/21
 Data sources: NEARMAP, NSW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

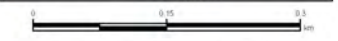
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Figure 2.4
Aquatic habitat assessment survey locations



Legend

- Aquatic habitat assessment
- Study area
- REF proposal area



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 21/04/21
 Data sources: - NEARmap, TNSW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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Table 2.8 Survey effort for candidate threatened flora species

Scientific name	Common name	BC Act ¹	EPBC Act ²	Optimal survey period (TBDC)	Survey technique	Survey timing
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	All year	BAM VI plots, parallel line traverses, random meanders and opportunistic sightings whilst conducting other surveys.	21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Acacia pubescens</i>	Downy Wattle	V	V	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Allocasuarina glareicola</i>	–	E	E	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Persoonia nutans</i>	Nodding Geebung	E	E	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	–	October to January		15 November; 4 December 2018 and 1 October 2020
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	August to November		19 September 2018; 15 November 2018; 29 and 30 September and 1 October 2020
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-Leaved Grevillea	V	–	All year		15 November; 4 December 2018 and 1 October 2020
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	V	August to October		19 September 2018; 29 and 30 September and 1 October 2020
<i>Hibbertia fumana</i>	–	CE	–	October to December		15 November; 4 December 2018 and 1 October 2020
<i>Hibbertia puberula</i>	–	E	–	October to December		15 November; 4 December 2018 and 1 October 2020
<i>Hibbertia puberula</i> subsp. <i>glabrescens</i> (syn. <i>Sp. Bankstown</i>)	–	CE	CE	September to December		15 November; 4 December 2018 and 1 October 2020

Scientific name	Common name	BC Act ¹	EPBC Act ²	Optimal survey period (TBDC)	Survey technique	Survey timing
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	–	E	–	October to January		15 November; 4 December 2018 and 1 October 2020
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	<i>Marsdenia viridiflora</i> R. Br. subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2	–	November to February		15 November; 4 December 2018 and 1 October 2020
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Pultenaea parviflora</i>	–	E	V	September to November		19 September; 15 November 2018; 29 and 30 September 2020 and 1 October 2020
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V	September to October		19 September 2018; 29 and 30 September 2020 and 1 October 2020
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	–	V	–	September to October		19 September 2018; 29 and 30 September 2020 and 1 October 2020

Scientific name	Common name	BC Act ¹	EPBC Act ²	Optimal survey period (TBDC)	Survey technique	Survey timing
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E	–	September to November		19 September; 15 November 2018; 29 and 30 September 2020 and 1 October 2020
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E2	–	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	V	–	All year		21–25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6–7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Dillwynia tenuifolia</i>	–	V, E2	–	August to October		6–7 April 2020
<i>Thesium australe</i>	Austral Toadflax	V	V	January to February		6–7 April 2020

1. Listed under the NSW Biodiversity Conservation Act 2016 – CE = Critically Endangered, E = Endangered, EP = Endangered Population, V = Vulnerable
2. Listed under the Commonwealth Environment Protection and Biodiversity Act 1999 - CE = Critically Endangered, E = Endangered, V = Vulnerable, M= Migratory
3. As associated with BAM calculator
4. As listed in the BioNet portal database (OEH, 2018)

Table 2.9 Survey effort for candidate threatened fauna species

Scientific name	Common name	BC Act ¹	EPBC Act ²	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Amphibians							
Green and Golden Bell Frog	<i>Litoria aurea</i>	E	V	Species	Nocturnal call playback (One playback on each of two separate nights) Systematic day habitat search (One hour per stratification unit) Night habitat search of damp and watery sites (30 minutes on two separate nights) Night watercourse search (Two hours per 200 m of water body edge) Minimum of one site per defined water body (retaining potential habitat) in the early evening and completed on each of four separate nights.	TBDC: November–March	4–5 December & 12–13 December 2018: <ul style="list-style-type: none"> • Call playback (4 nights after heavy rainfall event (>50mm). Multiple sites • Spotlighting and active searches – 26 person hours • 4 days of opportunistic sightings
Birds – migratory and shorebirds							
Curlew Sandpiper	<i>Calidris ferruginea</i>	E	CE; M; Ma	Dual species/ ecosystem	Standard 20 minute search of a 2ha area Incidental records	TBDC: n/a Other: September – March	4–5 December & 12–13 December 2018: <ul style="list-style-type: none"> • 20-minute shorebird surveys

Scientific name	Common name	BC Act ¹	EPBC Act ²	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Birds – predatory							
Eastern Osprey	<i>Pandion cristatus</i>	V	–	Dual species/ ecosystem	Standard 20 minute search of a 2ha area Incidental record	TBDC: April to November	21–25 May 2018: <ul style="list-style-type: none"> • 16 person hours • 5 days of opportunistic sightings (70 person hours) 6–7 April 2020: <ul style="list-style-type: none"> • 14 hours • 2 days of opportunistic sightings 19 September, 15 November and 4 December 2018: <ul style="list-style-type: none"> • 21 hours • 3 days of opportunistic sightings 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> • 21 hours • 3 days of opportunistic sightings
Little Eagle	<i>Hieraaetus morphnoides</i>	V	–	Dual species/ ecosystem	Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests	TBDC: August to October	
Square-tailed Kite	<i>Lophoictinia isura</i>	V	–	Dual species/ ecosystem		TBDC: September to January	
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	Ma	Dual species/ ecosystem		TBDC: July to December	

Scientific name	Common name	BC Act ¹	EPBC Act ²	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Birds – large forest owls							
Masked Owl	<i>Tyto novaehollandiae</i>	V	–	Dual species/ ecosystem	Call playback (5 visits per site for Powerful Owl, Barking Owl & and 8 visits per site for the Masked Owl). Spotlight surveys Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests	TBDC: May – August	21–25 May 2018: <ul style="list-style-type: none"> • Call playback – 4 consecutive nights across multiple sites • Spotlighting – 4 consecutive nights (16 person hours)
Powerful Owl	<i>Ninox strenua</i>	V	–	Dual species/ ecosystem		TBDC: May – August	
Birds – other							
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	–	Ecosystem	Standard 20 minute search of a 2ha area. Two separate one-day survey completed over study area in appropriate habitat within optimum season Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests	TBDC: n/a Other: All year	21–25 May 2018: <ul style="list-style-type: none"> • 6 person hours • 5 days of opportunistic sightings (70 person hours)
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	–	Dual species/ ecosystem		TBDC: April to August	
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	–	Ecosystem		TBDC: n/a Other: All year	4–5 December & 12–13 December 2018: <ul style="list-style-type: none"> • 4 days of opportunistic sightings
Rufous Fantail	<i>Rhipidura rufifrons</i>	–	M; Ma	n/a		TBDC: n/a Other: All year	
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	–	Ecosystem		TBDC: n/a Other: All year	6–7 April 2020: <ul style="list-style-type: none"> • 14 hours • 2 days of opportunistic sightings 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> • 21 hours • 3 days of opportunistic sightings
White-throated Needle-tail	<i>Hirundapus caudacutus</i>	–	V; M; Ma	Species		TBDC: October to April	

Scientific name	Common name	BC Act ¹	EPBC Act ²	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Swift Parrot	<i>Lathamus discolor</i>	E	CE	Dual species/ ecosystem	EPBC survey guidelines: Targeted searches for 20 hours over 8 days Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests (note: species only breeds in Tasmania).	TBDC: n/a Other: Mar–July (May–Aug breeding)	21–25 May 2018: <ul style="list-style-type: none"> • 16 person hours • 5 days of opportunistic sightings (70 person hours) 6–7 April 2020: <ul style="list-style-type: none"> • 14 hours • 2 days of opportunistic sightings
Invertebrates							
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E	–	Species	Actives searches – diurnal searches per fauna habitat stratification	TBDC: All year	21–25 May 2018: <ul style="list-style-type: none"> • Active searches within relevant habitat (16 person hours)
Mammals							
Koala	<i>Phascolarctos cinereus</i>	V	V	Dual species/ ecosystem	Call playback for relevant species (2 sites surveyed on 2 nights) Spotlight surveys (2 observers on 1 km transect for 1 hour) Camera traps – remote sensing cameras per fauna habitat stratification for four nights SATs Incidental records	TBDC: All year	21–25 May 2018: <ul style="list-style-type: none"> • Spotlighting – 4 consecutive nights (16 person hours) • SATs x4 within relevant PCTs with food trees • Call playback – 4 consecutive nights across multiple sites • 5 days of opportunistic sightings (70 person hours)

Scientific name	Common name	BC Act ¹	EPBC Act ²	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	–	Species	Call playback for relevant species (2 sites surveyed on 2 nights) Spotlight surveys (2 observers on 1 km transect for 1 hour) Camera traps – remote sensing cameras per fauna habitat stratification for four nights Incidental records	TBDC: All year	21–25 May 2018: <ul style="list-style-type: none"> Spotlighting – 4 consecutive nights (16 person hours) Remote cameras (28 trap nights) Call playback – 4 consecutive nights across multiple sites
Mammals – bats							
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	–	Ecosystem	Active and passive ultrasonic bat detection (Two recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights. Harp trapping (Four trap nights over two consecutive nights with one trap placed outside the flyways for one night). Breeding habitat (species credit breeding/important habitat components): searches of suitable habitat for actively used breeding habitat e.g. culverts, rocky cliffs etc.	TBDC: n/a Other: summer months	4–5 Dec & 12–13 Dec 2018: <ul style="list-style-type: none"> Anabat acoustic recordings – 20 recording nights at potential culverts/habitat over 4 nights
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	–	Ecosystem		TBDC: n/a Other: summer months	
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	–	Ecosystem		TBDC: n/a Other: summer months	7 April 2020: <ul style="list-style-type: none"> Daytime inspections of culverts and bridges for potential roosting sites 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> Daytime inspections of culverts and bridges for potential roosting sites
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	–	Dual species/ecosystem		TBDC: December to February	
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	Dual species/ecosystem		TBDC: November to January	
Little Bent-winged Bat	<i>Miniopterus australis</i>	V	–	Dual species/ecosystem		TBDC: December to January	
Southern Myotis	<i>Myotis macropus</i>	V	–	Species		TBDC: October to March	

Scientific name	Common name	BC Act ¹	EPBC Act ²	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	V	–	Ecosystem		TBDC: n/a Other: summer months	
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Dual species/ ecosystem	Spotlight surveys (2 observers on 1km transect for 1 hour) Daytime survey for roosting sites. Habitat assessment; habitat assessed for roosting potential, presence of camps and the presence of important (winter-flowering) feed trees	TBDC: October to December	21–25 May 2018: <ul style="list-style-type: none"> Spotlighting – 4 consecutive nights (16 person hours) 5 days of opportunistic sightings (70 person hours) – searches for daytime roosts 4–5 Dec & 12–13 Dec 2018: <ul style="list-style-type: none"> 20 person hours 4 nights of opportunistic sightings 6 & 7 April 2020: <ul style="list-style-type: none"> 30 person hours 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> 21 hours 3 days of opportunistic sightings

2.7 Limitations

No sampling technique can eliminate the possibility that a species is present within a study area. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present within the study area during surveys. The conclusions in this report are based upon data acquired for the REF proposal and the environmental field surveys, therefore, they are merely indicative of the environmental condition of the study area at the time of preparing the report, including the presence or otherwise of species. It should be recognised that study area conditions, including the presence of threatened species, can change with time.

Targeted surveys have been conducted to detect target sedentary animal species and threatened flora species that are considered likely to occur within the study area based on habitat characteristics and previous records. As the actual distribution and the range of habitat utilised by some species is not fully understood, there is always a small possibility that other species could occur on the site despite being considered to have a low likelihood of occurrence based on their known range and known habitats.

2.7.1 Other limitations

Other limitations relating to the conclusions contained in this report are detailed in the following sections.

Reliance on externally supplied information

In preparing this study, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations. Except as otherwise stated in the study, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this study (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

Study for benefit of client

This document has been prepared for the exclusive benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study).

Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

2.7.2 Changing circumstances

To the best of WSP's knowledge, the REF proposal presented, and the facts and matters described in this study reasonably represent the client's intentions at the time of preparation of the study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the REF proposal and of its possible environmental impact.

WSP will not be liable to update or revise this assessment to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the document.

3 Existing environment

This section describes the environmental context of the study area including abiotic and biotic features of the landscape area. The context of the study area assists in assessing likelihood of occurrence for threatened species and determining PCTs.

3.1 Summary of landscape features

The landscape context of the study area, including IBRA bioregions and subregions, Mitchell landscapes, catchment areas and land uses are described in Table 3.1.

Table 3.1 Landscape features

Landscape feature	Subject land
IBRA bioregions and subregions	Sydney Basin Bioregion/SYB08 Cumberland subregion
NSW landscape regions (Mitchell landscapes)	Ashfield Plains and Georges River Alluvial Plain
Local Government Area (LGA)	City of Canterbury – Bankstown Council
Native vegetation extent in the buffer area	Within the study area buffer, as defined in the BAM, native vegetation cover has been identified as 30–70%
Cleared areas	Cleared areas are associated with residential housing in the suburbs of Georges Hall, Bankstown Aerodrome and Milperra. Large cleared areas also occur on Bankstown Airport lands and golf courses that are adjacent to Henry Lawson Drive.
Rivers and streams	Georges River, Prospect Creek and associated tributaries
Wetlands	Several SEPP Coastal Management 2018 Coastal Wetlands and associated proximity buffers occur within the study area.
Connectivity features	Native vegetation within the study area provides connectivity to large patches on remnant native vegetation within Lansdowne Reserve and patches fringing Georges River and Prospect Creek.
Areas of Geological Significance and Soil Hazard Features	There are no areas identified to have geological significance. Potential high-risk acid sulphate soils, associated with low lying alluvial flats along the Georges River have been identified within the study area.
Areas of outstanding biodiversity value	None recorded

3.2 Plant community types

A total of seven NSW Plant Community Types (PCTs) were recorded in the study area. These are:

- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – moderate condition
- PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 – Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 920 – Mangrove Forest in Estuaries of the Sydney Basin and South East Corner
- PCT 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

In addition, three non-native vegetation types were assigned to a miscellaneous ecosystem class, being:

- miscellaneous ecosystem – urban exotic/native landscape plantings
- miscellaneous ecosystem – weeds/exotics – non- native vegetation
- miscellaneous ecosystem – waterbodies.

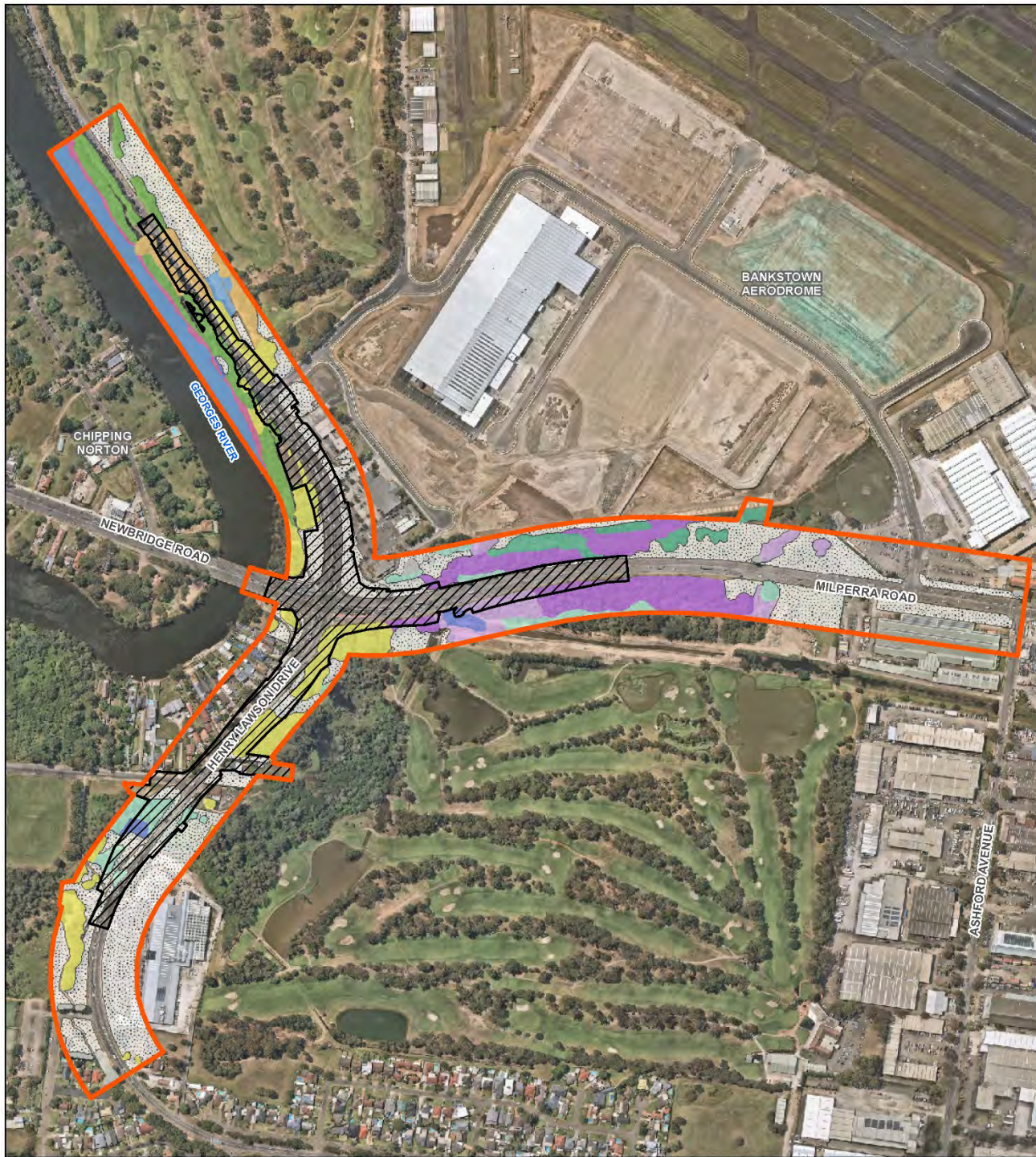
These seven native vegetation communities (listed above) were assigned to 14 discrete vegetation zones based on broad vegetation condition class criteria as outlined in Table 2.5. A summary of PCTs and associated vegetation zones are presented in Table 3.2 with the extent and distribution shown in Figure 3.1.

A detailed description of each PCT and justification for assigning the vegetation to each PCT and vegetation zone is provided below.

Table 3.2 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Study area (ha)
PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Moderate condition	Yes – Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion	2.33
	Poor condition (regrowth)	Yes – Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion	0.60
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Moderate condition	Yes – Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.21
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Moderate condition – Forest Red Gum variant	Yes – River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	2.32
	Moderate condition – Blue Box variant		0.64
PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner	Moderate condition	No	0.29
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Poor condition	Yes – Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.84
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Moderate condition	Yes – Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	1.32
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Poor condition	Yes – Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.90
Total extent of native vegetation			9.45

Plant community type (PCT)	Condition class	Threatened ecological community?	Study area (ha)
Miscellaneous ecosystem – Urban exotic/native landscape plantings	n/a	No	0.30
Miscellaneous ecosystem – Weeds/exotics – non-native vegetation	n/a	No	8.93
Miscellaneous ecosystem – Waterbodies	n/a	No	1.27
Total extent of non-native vegetation			10.50
Total native and non-native vegetation			19.95



Plant Community Types

- Miscellaneous ecosystem - Urban exotic / native landscape plantings
- Miscellaneous ecosystem - Waterbodies
- Miscellaneous ecosystem - Weeds / exotics – non-native vegetation
- 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition
- 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition
- 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition
- 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition
- 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Poor condition (regrowth): Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Poor condition (regrowth)
- 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition
- 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant): Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)
- 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant): Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)
- 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Moderate condition: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Moderate condition



HENRY LAWSON DRIVE STAGE 1A

Figure 3.1
Plant community types

Legend

- Study area
- ▨ REF proposal area



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 15-Jul-21
 Data sources - NEARMAP, TNSW, Geoscience Australia, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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PCT 725: Broad – leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.1, Photo 3.2, Photo 3.3 and Photo 3.4. An overview of floristic and structural composition is presented in Table 3.3 and Table 3.4. A general description is provided below.

Vegetation formation: KF_CH5A Dry Sclerophyll Forests (Shrubby/grass sub-formation)

Vegetation class: Cumberland Dry Sclerophyll Forests

PCT: 725 - Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion

Vegetation Zone: VZ1 and VZ1a

Extent in the study area: 2.93 ha

Conservation status:

- BC Act: Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – Endangered
- EPBC Act: Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion – Critically Endangered

Estimate of percent cleared: 95%

Landscape position: Low-lying clay plains associated with Tertiary alluvium. This vegetation type was recorded from Airport and Ashford Reserves within Stage 1A of the study area.

PCT Justification: In assigning this vegetation type, the following three candidate PCTs were considered based on floristic similarities and given the communities are known to intergrade:

- PCT 724 Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1067 – Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion.

Based on the overall strength of PCT 725 analysis, the landscape position of low-lying clay plains associated with Tertiary alluvium and the dominance of *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Eucalyptus longifolia* (Woollybutt) and *Melaleuca decora* (White Feather Honeymyrtle), PCT 725 was considered the most closely aligned PCT to this vegetation type.

Condition: Two distinct vegetation zones were assigned within this vegetation type based on broad condition state. These are:

- Moderate condition: The vegetation was recorded in relatively intact condition although has exhibited previous disturbances and exhibits ongoing edge effects from Milperra Road, Bankstown Airport and surrounding commercial, industrial and recreational land uses. Photographic representation is presented in Photo 3.1 and Photo 3.2.
- Poor condition: This condition class is in a regeneration state due to historic clearing and disturbance (Photo 3.3 and Photo 3.4).

A comparison of PCT 725 - Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion plot data recorded against PCT condition benchmark data is provided in Table 3.4.

Vegetation integrity survey plots: Q1 and Q3 (moderate condition), and Q4 (poor condition). See Appendix A for full floristic and structural data.

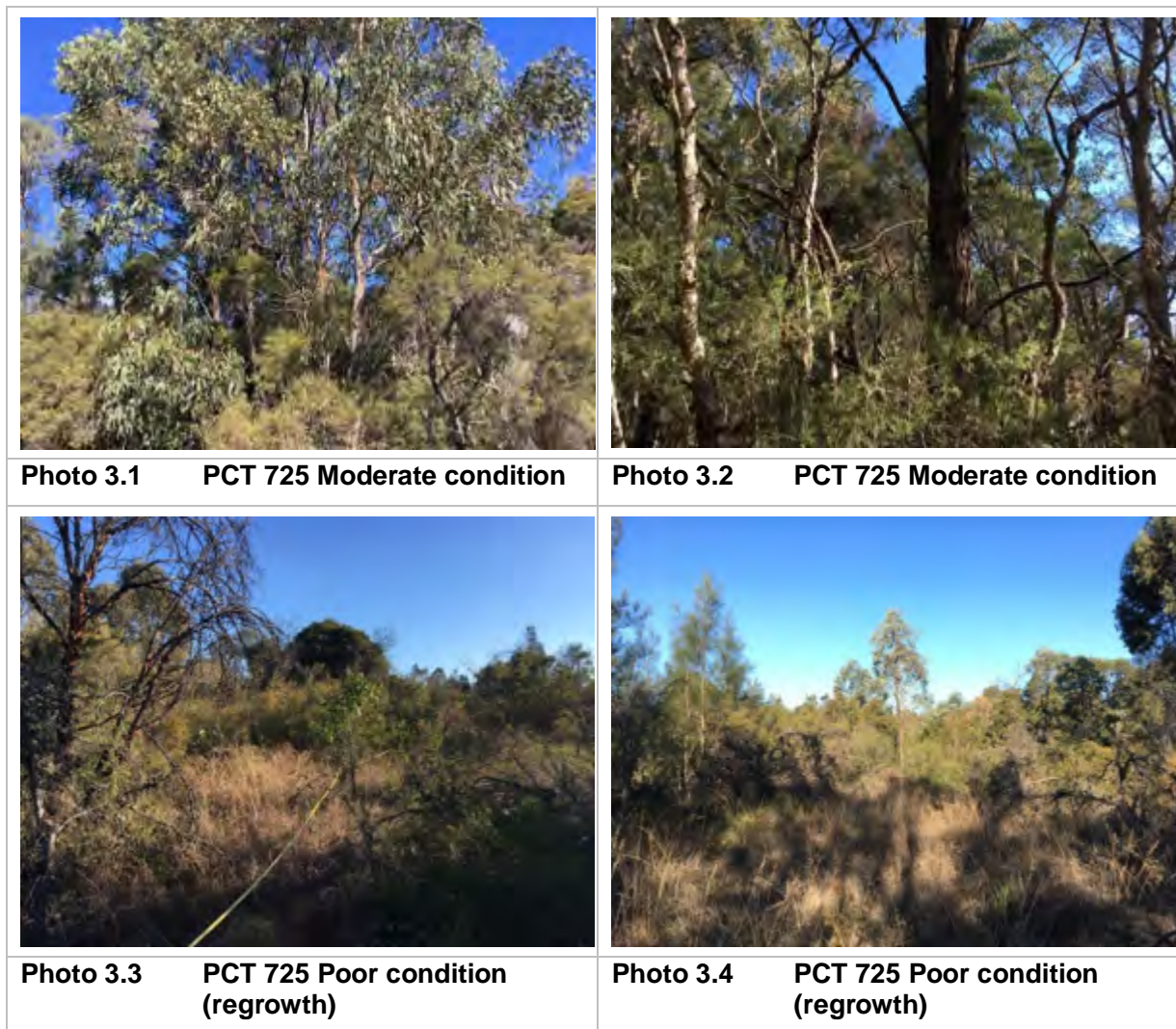


Table 3.3 PCT 725 overview of floristic and structural composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	16.1	<i>Eucalyptus fibrosa</i> (Broad-leaved Ironbark), <i>Eucalyptus longifolia</i> (Woollybutt), <i>Melaleuca decora</i> (White Feather Honey Myrtle), <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (Parramatta Red Gum), <i>Angophora floribunda</i> (Rough-barked Apple), <i>Casuarina glauca</i> (Swamp Oak), <i>Eucalyptus sideroxylon</i> (Mugga Ironbark)
Shrubs	35.3	<i>Melaleuca decora</i> (White Feather Honey Myrtle), <i>Melaleuca nodosa</i> (Ball Honey Myrtle), <i>Bursaria spinosa</i> subsp. <i>spinosa</i> (Native Blackthorn), <i>Leucopogon juniperinus</i> (Prickly Beard-heath), <i>Acacia falcata</i> (Hickory Wattle), <i>Hakea sericea</i> (Needlebush), <i>Kunzea ambigua</i> (Tick Bush),
Grass and grass like	18.6	<i>Entolasia stricta</i> (Wiry Panic), <i>Dichelachne micrantha</i> (Shorthair Plumegrass), <i>Lomandra longifolia</i> (Spiked Mat-rush), <i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Grass), <i>Aristida vagans</i> (Threeawn Speargrass), <i>Eragrostis brownii</i> (Brown's Lovegrass),
Forb	8.5	<i>Dianella revoluta</i> var. <i>revolute</i> (Blue Flax-lily), <i>Dianella longifolia</i> (Blueberry Lily), <i>Dichondra repens</i> (Kidney Weed)
Fern	0.9	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> (Rock Fern)
Other	3.1	<i>Billardiera scandens</i> (Hairy Apple Berry), <i>Cassytha glabella</i> f. <i>glabella</i> , <i>Clematis glycinoides</i> var. <i>glycinoides</i> (Headache Vine), <i>Glycine tabacina</i> , <i>Hardenbergia violacea</i> (False Sarsaparilla)

Growth form	Average % foliage cover	Dominant species (native and exotic)
Exotic	20.2	<i>Passiflora subpeltata</i> * (White Passionfruit), <i>Briza subaristata</i> *, <i>Coreopsis lanceolata</i> * (Coreopsis)
High threat weed	16.6	<i>Araujia sericifera</i> * (Moth Vine), <i>Asparagus asparagoides</i> * (Bridal Creeper), <i>Eragrostis curvula</i> * (African Lovegrass), <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> * (Bitou Bush), <i>Ligustrum sinense</i> * (Small-leaved Privet), <i>Ochna serrulata</i> * (Mickey Mouse Plant)

Table 3.4 Comparison of PCT 725 – Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	5	11	13	12	1	4	42	34	47	6	1	2	68	60	3(50)
Q1	6	12	8	6	1	5	16.8	42.6	19.4	4.3	1	4.7	16.5	58	0
Q3	4	6	9	8	1	5	27.8	40.9	22.4	20.1	0.5	3.8	8.5	79	0
Q4	3	12	12	5	2	1	3.8	22.4	14	1.2	1.2	0.8	4	37	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 725 - Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion Keith Formation KF_CH5A Dry Sclerophyll Forests (Shrubby/grass sub-formation) Keith Class: Cumberland Dry Sclerophyll Forests, source (Office of Environment & Heritage 2018).

PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1. with photographic representation provided in Photo 3.5, Photo 3.6, Photo 3.7 and Photo 3.8. An overview of floristic and structural composition is presented in Table 3.5 and Table 3.6. A general description is provided below.

Vegetation formation: KF_CH9 Forested Wetland

Vegetation class: Coastal Floodplain Wetland

PCT: 835 – Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

Vegetation Zone: VZ3 and VZ4

Extent in the study area: 2.96 ha

Conservation status:

- BC Act: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered
- EPBC Act: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner bioregions – Critically Endangered

Estimate of percent cleared: 93%

Landscape position: occurs on with poorly drained alluvial flats of the Georges River and associated tributaries.

PCT Justification: landscape position on alluvial flats and dominant canopy species, *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum), *Eucalyptus tereticornis* (Forest Red Gum), *Angophora floribunda* (Rough-barked Apple) are consistent with the PCT description of PCT 835.

Vegetation zones: Within the study area, PCT 835 was recorded in a single condition class that was allocated to two discrete vegetation zones based on dominance of canopy species. Two distinct vegetation zones were assigned within this vegetation type based on broad condition state. These are:

- *Forest Red Gum variant:* The canopy of this vegetation zone was dominated by *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum) and *Eucalyptus tereticornis* (Forest Red Gum). Slight variation was floristic structure and composition was observed with some patches having a managed understorey. All patches were observed to exhibit moderate weed incursions.
- *Blue Box variant:* The vegetation zone was recorded on low-lying areas fringing the Georges River and graded into PCT 1234. The vegetation zone was dominated by *Eucalyptus baueriana* (Blue Box) with most patches occurring adjacent to Henry Lawson Drive between the intersection of Milperra Road and Rabaul Road.

Condition: Moderate – the vegetation was recorded in relatively intact condition although has exhibited previous disturbances and exhibits ongoing edge effects from Milperra Road, Bankstown Airport and surrounding commercial, industrial and recreational land uses. A comparison of PCT 835 – Forest Red Gum – Rough – barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin plot data recorded against PCT condition benchmark data is provided in Table 3.6.

Vegetation integrity survey plots: Q12, Q18 and Q24 (Forest Red Gum variant), and Q7 (from WSP, 2018) (Blue Box variant). Q7 (WSP, 2018) from the Stage 2 development area due small patch size within the Stage 1a study area. See Appendix A for full floristic and structural data.

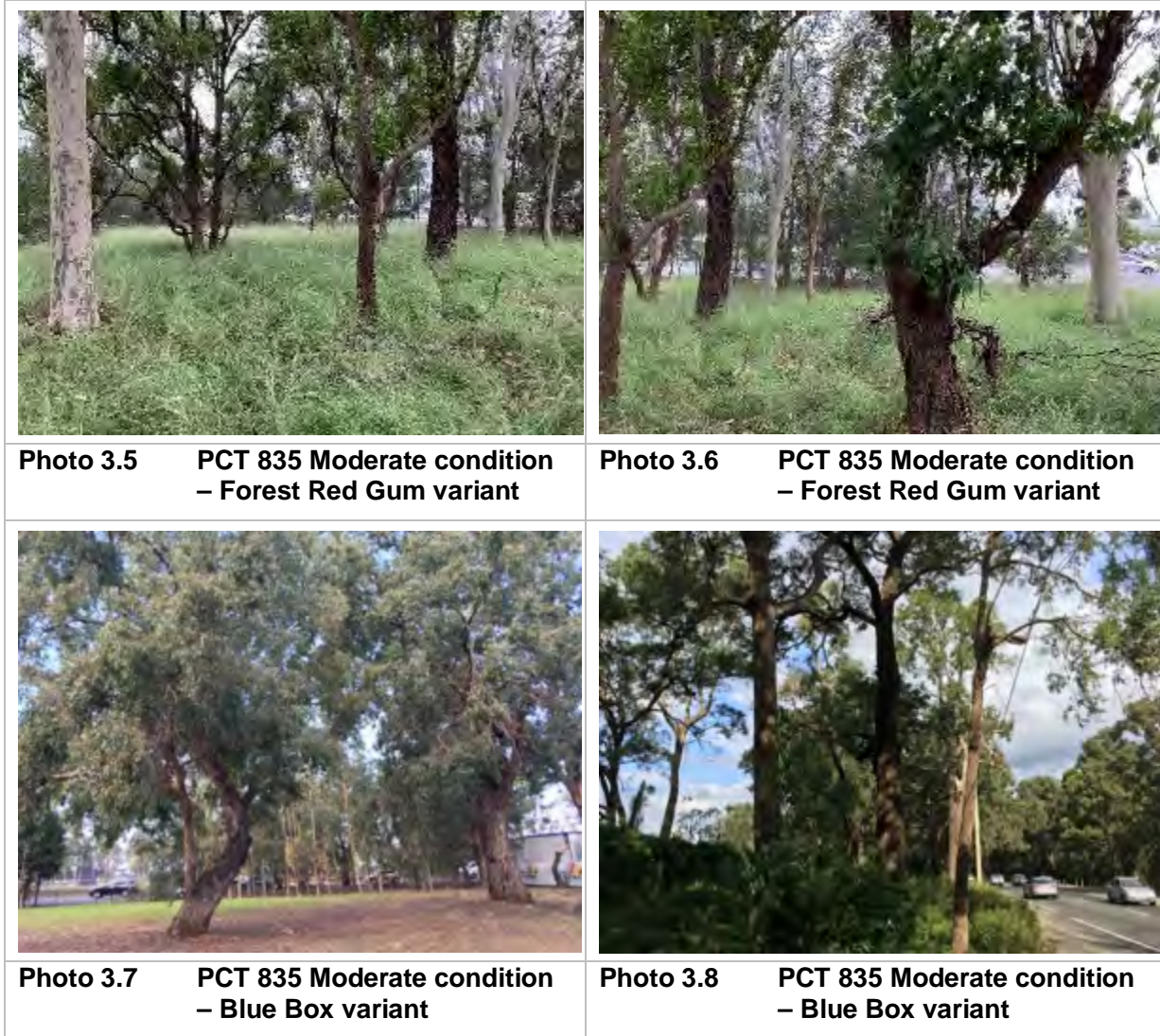


Table 3.5 PCT 835 overview of floristic and structural composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	39.7	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i> (Cabbage Gum), <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>Angophora floribunda</i> (Rough-barked Apple), <i>Eucalyptus fibrosa</i> (Red Ironbark), <i>Acacia decurrens</i> (Green Wattle), <i>Corymbia maculata</i> (Spotted gum)
Shrubs	13.1	<i>Melaleuca styphelioides</i> (Prickly-leaved Paperbark), <i>Melaleuca decora</i> (White Feather Myrtle), <i>Melaleuca linariifolia</i> (Snow-in Summer),
Grass and grass like	1.8	<i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Grass), <i>Cynodon dactylon</i> (Couch), <i>Carex appressa</i> (Tall sedge)
Forb	5.2	<i>Einadia hastata</i> (Berry Saltbush), <i>Tetragonia tetragoides</i> (New Zealand Spinach)
Fern	0	-
Other	0.9	<i>Cayratia clematidea</i> (Native Grape), <i>Glycine clandestine</i> (Twining glycine)

Growth form	Average % foliage cover	Dominant species (native and exotic)
Exotic	58.8	<i>Bidens pilosa</i> * (Cobblers Peg), <i>Conyza sumatrensis</i> * (Fleabane), <i>Euphorbia peplus</i> * (Milkweed), <i>Sida rhombifolia</i> * (Paddy's Lucerne)
High Threat Weed	51.3	<i>Cardiospermum grandiflorum</i> * (Ballon Vine), <i>Ehrharta erecta</i> * (Panic Veldtgrass) <i>Tradescantia fluminensis</i> * (Trad), <i>Panicum maximum var. maximum</i> (Guinea grass), <i>Eragrostis curvulua</i> (African love Grass)

Table 3.6 Comparison of PCT 835 – Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	4	8	8	8	2	4	22	22	70	3	1	1	12	40	1
Q7	4	2	3	2	0	1	51.4	21	3.9	10.6	0	3	0	62	7
Q12	4	4	1	3	0	1	19.4	29.4	0.2	1.2	0	1	0	57	2
Q18	4	1	2	4	0	1	40	0.7	2.3	8.8	0	0.4	10	74	7
Q24	8	4	1	0	0	0	48	1.1	0.6	0	0	0	0	60	5

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Keith Formation: KF_CH9 Forested Wetland Keith Class: Coastal Floodplain Wetland, source (Office of Environment & Heritage 2018).

PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.9 and Photo 3.10. An overview of floristic and structural composition is presented in Table 3.7 and Table 3.8. A general description provided below.

Vegetation formation: KF_CH8 Freshwater Wetlands

Vegetation class: Coastal Freshwater Wetlands

PCT: 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion

Vegetation Zone: VZ2

Extent in the study area: 0.21 ha

Conservation status:

- BC Act: Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – Endangered
- EPBC Act: Not listed

Estimate of percent cleared: 74%

Landscape position: Associated with creek tributaries and areas of standing water on alluvial flats.

PCT Justification: This vegetation type was recorded as treeless and contained a high proportion of wetland reeds and sedges associated with pools of standing freshwater.

Condition: Moderate – within the study area, PCT 781 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

This vegetation occurred in poorly drained areas of standing water that were typically associated with creek tributaries on alluvial flats. Photographic representation is presented in Photo 3.9 and Photo 3.10 with a summary of floristic composition in Table 3.7. A comparison of PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 3.10.

Vegetation integrity survey plots: Q23 see Appendix A for full floristic and structural data.



Photo 3.9 PCT 781 – moderate condition



Photo 3.10 PCT 781 – moderate condition

Table 3.7 PCT 781 overview of floristic and structural composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	1	<i>Grevillea robusta</i> (Silky Oak)
Shrubs	1	<i>Melaleuca ericifolia</i> (Swamp Paperbark)
Grass and grass like	30	<i>Phragmites australis</i> (Common Reed)
Forb	0	-
Fern	0	-
Other	0.8	<i>Cassytha glabella f. glabella</i>
Exotic	61.8	<i>Passiflora subpeltata</i> (White passion-flower), <i>Rubus fruticosus</i> (Blackberry)
High treat weed	42.4	<i>Acetosa sagittata</i> (Turkey Rhubarb), <i>Anredera cordifolia</i> (Madera Vine), <i>Cestrum parqui</i> (Green cestrum)

Table 3.8 Comparison of PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	1	2	4	4	1	0	0	0	102	2	0	0	60	25	2
Q23	1	1	1	0	0	1	1	1	30	0	0	0.8	0	0	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF_CH8 Freshwater Wetland Keith Class: Coastal Freshwater Wetland, source (Office of Environment & Heritage)

PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.11, and Photo 3.12. An overview of floristic and structural composition is presented in Table 3.9 and Table 3.10. A general description provided below.

Vegetation formation: KF_CH10 Saline Wetlands

Vegetation class: Mangrove Swamps

PCT: 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

Vegetation zone: VZ9

Extent in study area: 0.29 ha

Conservation status:

- BC Act: Not listed
- EPBC Act: Not listed

Estimate of percent cleared: 86%

Landscape position: Recorded from tidal mudflats fringing the Georges River

PCT Justification: In selecting the most representative PCT for this vegetation type, the following candidate PCTs were considered;

- PCT 916 – Mangrove – Grey Mangrove low closed forest of the NSW Coastal Bioregion
- PCT 918 – Mangrove – River Mangrove low closed forest of the NSW Coastal Bioregion
- PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

Based on the dominance of both *Aegiceras corniculatum* (River Mangrove), *Avicennia marina* subsp. *australasica* (Grey Mangrove) and the landscape position fringing a tidal portion of the Georges River PCT 920 was considered the closest representative PCT.

Condition: Moderate - within the study area, PCT 920 was recorded in a single condition class that was allocated to a single discrete vegetation zone. A comparison of PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 3.10.

Vegetation integrity survey plots: Q25. See Appendix A for full floristic and structural data.



Photo 3.11 PCT 920 Moderate condition



Photo 3.12 PCT 920 Moderate condition

Table 3.9 PCT 920 overview of floristic composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	62	<i>Avicennia marina</i> subsp. <i>australasica</i> (Grey Mangrove), <i>Casuarina glauca</i> (Swamp sheoak)
Shrubs	45	<i>Aegiceras corniculatum</i> (River mangrove)
Grass and grass like	0	-
Forb	0.8	<i>Tetragonia tetragoinioides</i> (New Zealand Spinach)
Fern	0	-
Other	0	-
Exotic	0.3	<i>Atriplex prostrata</i> * (Spear – leaved Orache)
High threat weed	0	-

Table 3.10 Comparison of PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	2	2	2	2	0	1	38	5	0	0	0	0	0	20	0
Q25	2	1	0	1	0	0	62	45	0	0.8	0	0	11	1.6	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 920 - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF_CH10 Saline Wetlands Keith Class: Mangrove Swamps, source (Office of Environment & Heritage 2018

PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.13 and Photo 3.14. An overview of floristic and structural composition is presented in Table 3.11 and Table 3.12. A general description is provided below.

Vegetation formation: KF_CH9 Forested Wetland

Vegetation class: Coastal Floodplain Wetland

PCT: 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion

Vegetation zone: VZ11

Extent in study area: 0.84 ha

Conservation status:

- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered
- EPBC Act: Not listed

Estimate of percent cleared: 32%

Landscape position: located on periodically flooded low-lying areas and drainage tributaries of the Georges River. This vegetation zone was wholly located within Stage 1A of the study area and generally occurred in areas of restricted drainage within Airport and Ashford Reserves.

PCT Justification: This vegetation type is dominated by *Melaleuca ericifolia* (Swamp Paperbark) and *Melaleuca linariifolia* (Snow-in Summer) along with sedges and reeds. The floristic composition and landscape position is consistent with PCT 1236. This community intergrades with PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

Condition: Moderate - within the study area, PCT 1236 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

A comparison of PCT 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 3.12.

Vegetation integrity survey plots: Q2. See Appendix A for full floristic data.



Photo 3.13 PCT 1236 Moderate condition



Photo 3.14 PCT 1236 Moderate condition

Table 3.11 PCT 1236 overview of floristic composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	0	-
Shrubs	33	<i>Melaleuca ericifolia</i> (Swamp Paperbark), <i>Melaleuca linariifolia</i> (Snow-in Summer)
Grass and grass like	74	<i>Carex appressa</i> (Tall Sedge), <i>Phragmites australis</i> (Common Reed), <i>Typha orientalis</i> (Cumbungi)
Forb	12.5	<i>Commelina cyanea</i> (Native Wandering Jew), <i>Persicaria hydropiper</i> (Water Pepper), <i>Persicaria lapathifolia</i> (Pale Knotweed)
Fern	0	-
Other	0	-
Exotic	0	-
High threat weed	10.8	<i>Alternanthera philoxeroides</i> * (Alligator Weed), <i>Erythrina crista-galli</i> * (Cockspur Coral Tree), <i>Tradscantia fluminensis</i> * (Wandering Jew)

Table 3.12 Comparison of PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	3	9	8	8	2	5	12	25	75	3	1	1	12	40	1
Q2	0	2	3	3	0	0	0	33	74	12.5	0	0	3	10	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF_CH9 Forested Wetland, Keith Class: Coastal Floodplain Wetland, source (Office of Environment & Heritage 2018).

PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.15 and Photo 3.16. An overview of floristic and structural composition is presented in Table 3.13 and Table 3.14. A general description is provided below.

Vegetation formation: KF_CH9 Forested Wetland

Vegetation class: Coastal Floodplain Wetland

PCT: 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion

Vegetation zone: VZ12

Extent in study area: 1.32 ha

Conservation status:

- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered
- EPBC Act: Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – Endangered

Estimate of percent cleared: 90%

Landscape position: This vegetation type was associated with tidal flats of the Georges River

PCT Justification: A canopy dominated by *Casuarina glauca* (Swamp Oak) that is associated with tidal influences of groundwater levels. PCT 1800 was considered as a candidate for this vegetation type however due to the tidal influences of the Georges River, PCT 1234 was assigned as the most appropriate fit.

Condition: Moderate – within the study area, PCT 1234 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

A comparison of PCT 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 3.14.

Vegetation integrity survey plots: Q21. See Appendix A for full floristic data.



Photo 3.15 PCT 1234 Moderate condition



Photo 3.16 PCT 1234 Moderate condition

Table 3.13 PCT 1234 overview of floristic composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	65	<i>Acacia binervia</i> (Two-veined Hickory), <i>Acacia parramattensis</i> (Parramatta Wattle), <i>Casuarina glauca</i> (Swamp Oak),
Shrubs	12	<i>Melaleuca styphelioides</i> (Prickly-leaved Paperbark), <i>Melaleuca decora</i> (White feather honeymyrtle), <i>Bursaria spinosa subsp. spinosa</i> (Native Blackthorn)
Grass and grass like	5	<i>Microleana stipoides var. stipoides</i> (Weeping grass)
Forb	4.6	<i>Tetragonia tetragonioides</i> (New Zealand Spinach), <i>Dichondra repens</i> (Kidney Weed), <i>Einadia hastata</i> (Berry Saltbush), <i>Solanum americanum</i> (Glossy Nightshade).
Fern	0	-
Other	0	-
Exotic	42.4	<i>Bidens pilosa</i> * (Farmer' friend), <i>Oxalis corniculata</i> * (Creeping Woodsorrel), <i>Sonchus oleraceus</i> * (Common Sowthistle)
High threat weed	38.3	<i>Ehrharta erecta</i> * (Panic Veldt Grass), <i>Tradescantia fluminensis</i> * (Wandering Jew)

Table 3.14 Comparison of PCT 1234: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	3	9	8	8	2	5	12	25	75	3	1	1	12	40	1
Q21	3	3	1	4	0	0	65	12	5	4.6	0	0	21	47	1

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type PCT 1234: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF_CH9 Forested Wetland, Keith Class: Coastal Floodplain Wetland, source (Office of Environment & Heritage 2018).

PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.17 and Photo 3.18. An overview of floristic and structural composition is presented in Table 3.15 and Table 3.16. A general description is provided below.

Vegetation formation: KF_CH9 Forested Wetland

Vegetation class: Coastal Floodplain Wetland

PCT: 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

Vegetation zone: VZ13

Extent in study area: 0.90 ha

Conservation status:

- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered
- EPBC Act: Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – Endangered

Estimate of percent cleared: 60%

Landscape position: This vegetation type was associated with low-lying, periodically inundated alluvial riverflats in non-tidal areas. This vegetation zone occurred in scattered locations associated with disturbed drainage lines and depressions.

PCT Justification: A canopy dominated by *Casuarina glauca* (Swamp Oak) that is associated with low-lying, periodically inundated alluvial riverflats of the Cumberland Plain.

Condition: Poor – within the study area, PCT 1800 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

A comparison of PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley plot data recorded against PCT condition benchmark data is provided in Table 3.16.

Vegetation integrity survey plots: Q20 and Q26. See Appendix A for full floristic data.



Photo 3.17 PCT 1800 Poor condition



Photo 3.18 PCT 1800 Poor condition

Table 3.15 PCT 1800 overview of floristic composition

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	37.5	<i>Casuarina glauca</i> (Swamp Oak)
Shrubs	0.5	<i>Melaleuca ericifolia</i> (Swamp Paperbark), <i>Aegiceras corniculatum</i> (River Mangrove)
Grass and grass like	0.2	<i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Grass)
Forb	20	<i>Tetragonia tetragonioides</i> (New Zealand Spinach)
Fern	0	-
Other	0	-
Exotic	85.8	<i>Yucca sp.</i> *, <i>Syagrus romanzoffiana</i> * (Queen Palm)
High threat weed	76.6	<i>Ehrharta erecta</i> * (Panic Veldt Grass) <i>Tradescantia fluminensis</i> * (Wandering Jew), <i>Arundo donax</i> * (Giant Reed)

Table 3.16 Comparison of PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley plot data against PCT condition benchmark data

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
BM	4	8	8	8	2	4	22	22	70	3	1	1	12	40	1
Q20	1	0	1	0	0	0	35	0	0.2	0	0	0	5	70	0
Q26	1	2	1	1	0	0	40	0.9	0.1	40	0	0	0	40	3

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley Keith Formation: KF_CH9 Forested Wetland, Keith Class: Coastal Floodplain Wetland, source (Office of Environment & Heritage 2018).

3.3 Miscellaneous ecosystems

3.3.1 Miscellaneous ecosystem - Urban exotic / native landscape plantings

This vegetation type does not align to any recognised plant community type in NSW due to its limited native vegetation and degraded condition. As such, it has been aligned to Highly disturbed areas with no or limited native vegetation. Within the study area this vegetation type was consistently recorded in all stages with the extent of being approximately: Photographic representation is provided in Photo 3.19 and Photo 3.20.

Vegetation Zone: VZ14

Extent in the study area: 0.30 ha

This vegetation type was typically recorded as planted canopy species fringing Henry Lawson Drive and within Bankstown Golf Club. This vegetation is highly modified with exotic vegetation dominating the understorey. These areas have been historically cleared of the original native vegetation and planted with the following:

- Landscape plantings of species which are locally indigenous to the Sydney Basin bioregion (e.g. *Melaleuca styphelioides* (Prickly-leaved Tea Tree), *Casuarina glauca* (Swamp Oak), *Corymbia maculata* (Spotted Gum) and assorted other species)
- Landscape plantings of plant species which are native to NSW but not locally indigenous species (e.g. *Eucalyptus microcorys* (Tallowwood))
- Landscape plantings of species that are not indigenous to NSW but are indigenous in other parts of Australia (e.g. *Corymbia citriodora* (Lemon-scented Gum), *Ficus microcarpa* (Chinese Banyan))
- Landscape plantings of species that are exotic (not indigenous to Australia) (e.g. *Phoenix canariensis** (Canary Island Date Palm), *Jacaranda mimosifolia** (Jacaranda), *Cinnamomum camphora** (Camphor Laurel)).



Photo 3.19 Misc. Ecosystem – Urban exotic/ native landscape plantings



Photo 3.20 Misc. Ecosystem – Urban exotic/ native landscape plantings

3.3.2 Miscellaneous ecosystem – Weeds / exotics – non-native vegetation

This vegetation type does not align to any recognised plant community type in NSW due to its limited native vegetation and degraded condition. As such, it has been aligned to Highly disturbed areas with no or limited native vegetation. Within the study area this vegetation type was consistently recorded in all stages with the extent of being approximately: Photographic representation is provided in Photo 3.21 and Photo 3.22.

Vegetation zone: VZ15

Extent in the study area: 8.94 ha

Associated with cleared areas typically dominated by exotic perennial grass species such as *Axonopus fissifolius** (Narrow-leaf Carpet Grass), *Cenchrus clandestinus** (Kikuyu), *Eragrostis curvula** (African Love Grass) and *Paspalum dilatatum** (Paspalum). This vegetation zone also includes weed plumes such as *Lantana camara* (Lantana) and *Rubus fruticosus agg.** (Blackberry).



Photo 3.21 Miscellaneous ecosystem – Highly disturbed areas with no or limited native vegetation (Weeds / exotics – non-native vegetation)



Photo 3.22 Miscellaneous ecosystem – Highly disturbed areas with no or limited native vegetation (Weeds / exotics – non-native vegetation)

3.3.3 Miscellaneous ecosystem – Waterbodies

Within the study area water bodies associated with Georges River have been aligned to water bodies, rivers, lakes, streams (not wetlands). Photographic representation is presented below as Photo 3.23 and Photo 3.24.

Extent in the study area: 1.27 ha



Photo 3.23 Water body – Georges River



Photo 3.24 Water body – tributary of Georges River

3.4 Flora recorded

Within the REF proposal study area, a total of 179 flora species were recorded. Of these, 98 were native indigenous (55%) and 81 were non-native exotic species (45%). Two threatened flora species were recorded within the study area, *Callistemon linearifolius* (Netted Bottle Brush) listed as vulnerable on the BC Act and *Acacia pubescens* (Downy Wattle), which is listed as vulnerable under the BC Act and vulnerable under the EPBC Act.

A full inventory of flora species recorded and vegetation integrity plot data is presented in Appendix A.

3.4.1 Priority Weeds

Of the 98 recorded exotic species, six are listed as Priority Weeds under the NSW *Biosecurity Act 2015* (Biosecurity Act) for the Greater Sydney Local Land Service region and are also listed Weeds of National Significance (WONS) (Table 3.17). Under the Biosecurity Act, land managers are required to follow the regional and non-regional duties which have been allocated to each Priority Weed.

Table 3.17 Weeds of concern recorded within the study area

Scientific name	Common name	Priority weed duty	WONS
<i>Alternanthera philoxeroides</i> *	Alligator Weed	Prohibition on dealings Must not be imported into the State or sold	Yes
<i>Anredera cordifolia</i> *	Madeira Vine		Yes
<i>Asparagus aethiopicus</i> *	Asparagus fern		Yes
<i>Asparagus asparagoides</i> *	Bridal Creeper		Yes
<i>Lantana camara</i> *	Lantana		Yes
<i>Rubus fruticosus agg</i> *	Blackberry		Yes
<i>Senecio madagascariensis</i> *	Fireweed		Yes

3.5 Threatened ecological communities

A total of four threatened ecological communities (TECs) listed under the BC Act were recorded within the study area. These are;

- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

A summary of each four listed TEC's listed above, associated PCT and extent within the study area is summaries in Table 3.18.

The presence and extent of TECs in the study area is described in Table 3.19, Table 3.20, Table 3.21 and Table 3.22. The description includes specific details of how each PCT meets each element of the scientific determination, including how many characteristic species occur and details of the soils and geology associated with the PCT.

The location of each TEC in relation to the study area is provided in Figure 3.2.

Table 3.18 A summary of threatened ecological communities listed under the BC Act recorded within the study area.

Threatened ecological community	Status	Associated PCT within the study area	Extent within the study area (ha)
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	E	PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	2.93
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion	0.21
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin Bioregion	2.96
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0.84
		PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion	1.32
		PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	0.90
Total			9.16

3.5.1 Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

Table 3.19 Correlation of BC Act listed Cooks River/Castlereagh Ironbark Forest Community and associated PCT 725

Threatened ecological community and PCT comparison	Bioregion	Landform and altitudinal range	Soil/ geology	Structure	Species assemblage	Condition thresholds
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Sydney Basin	Found on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally, occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	Occurs on clay soils associated with Tertiary alluvium.	The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.	There are 88 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 725: Broad-leaved Ironbark - <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Sydney Basin	Recorded in wet areas where moist depressions and surface water were observed. Drainage lines associated within tributaries of Georges River were observed in Airport Reserve.	Clays derived from Tertiary alluvium.	Occurs as open forest	All vegetation assigned to this PCT was floristically characteristic of Cooks River/Castlereagh Ironbark Forest Community. Total diagnostic species per plot: <ul style="list-style-type: none"> • Q1 – 19 sp. • Q3 – 12 sp. 	This PCT was recorded in two condition types; Moderate and Poor (regrowth)
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

3.5.2 Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

Table 3.20 Correlation of BC Act listed Cumberland Plain Woodland Community and associated PCT 781

Threatened ecological community and PCT comparison	Bioregion	Landform and Altitudinal range	Soil/geology	Structure	Species assemblage	Condition thresholds
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	North Coast, Sydney Basin and South East Corner bioregions	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands.	Typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains.	The structure of the community may vary from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce. Typically dominated by herbaceous plants and have very few woody species	There are 66 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion	Sydney Basin	Recorded within low lying soak areas along Milperra Road.	Recorded in silt soils in moist alluvial depressions.	The vegetation is recorded as reedland.	All vegetation assigned to this PCT was floristically characteristic of Freshwater Wetlands. Total diagnostic species per plot: <ul style="list-style-type: none"> • Q23 – 1 sp. 	Patches of the community identified have characteristic native species dominant (>75% of species are characteristic) for at least one of the structural layers present.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

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

Table 3.21 Correlation of BC Act listed River Flat Eucalypt Forest Community and associated PCT 835.

Threatened ecological community and PCT comparison	Bioregion	Landform and Altitudinal range	Soil/geology	Structure	Species assemblage	Condition thresholds
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Threatened Ecological Community	North Coast, Sydney Basin and South East Corner bioregions	Found on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	Alluvium; silts, clay-loams and sandy loams	The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.	There are 88 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 835: Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Sydney Basin	Occurs on streams/drainage lines at <50 m elevation within the study area.	Occurs on alluvium and clay-loams within the study area.	Structure of the community on the site is variable, consisting of partially cleared open forest/woodland with or without a shrub layer.	All plots assigned to the PCT contain <i>Eucalyptus amplifolia</i> , <i>Eucalyptus tereticornis</i> or <i>Eucalyptus baueriana</i> and some diagnostic understorey species. Total diagnostic species per plot: <ul style="list-style-type: none"> • Q7 – 8 sp. Q12 – 8 sp. • Q18 – 10 sp. Q24–10 sp. 	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present. NB: tree and shrub layers are considered to be absent where they are only represented by isolated (widely-spaced) individuals.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

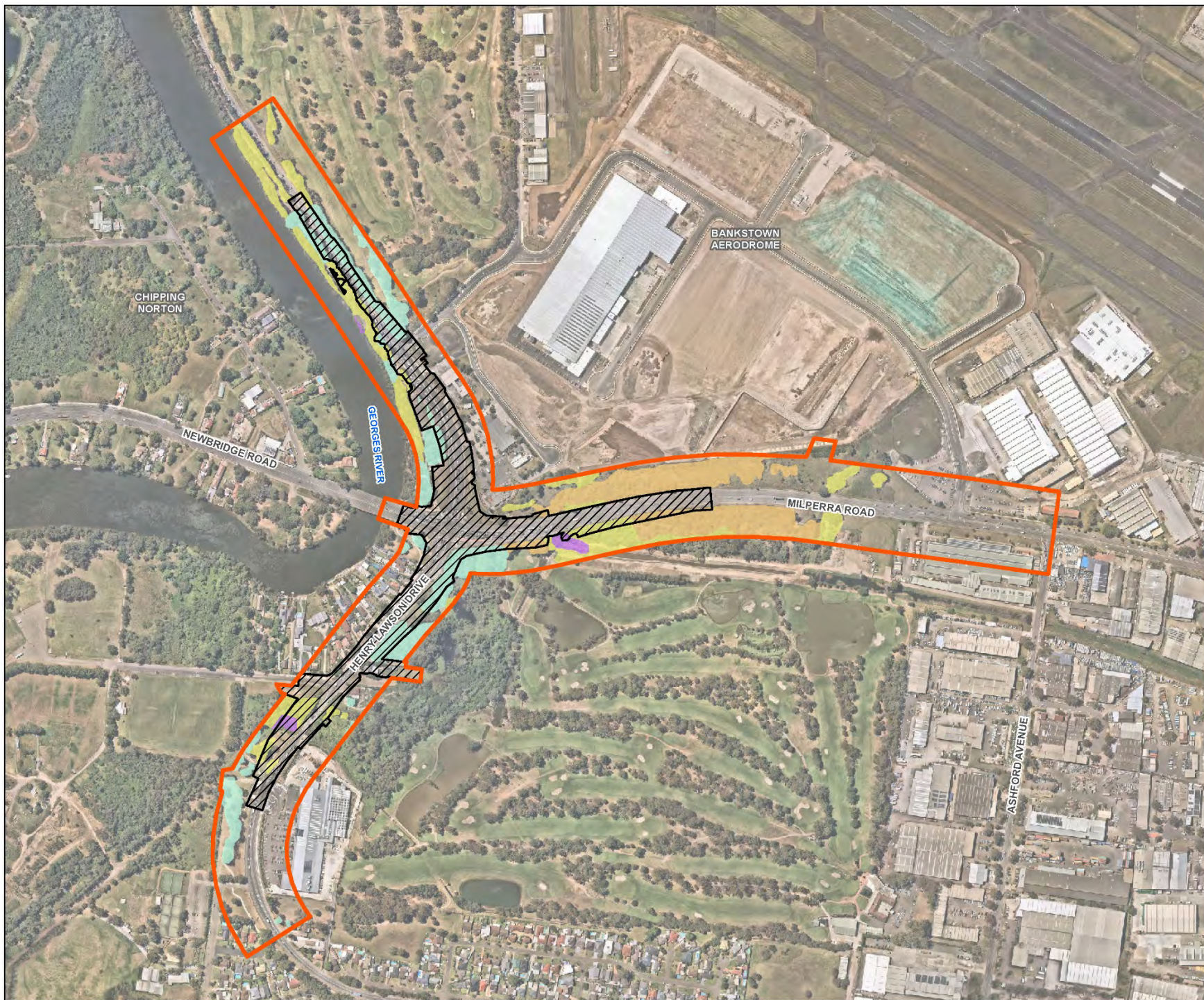
3.5.4 Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Table 3.22 Correlation of BC Act listed Swamp Oak Floodplain Community and associated PCT 1236, PCT 1234 and PCT 1800

Threatened ecological community and PCT comparison	Bioregion	Landform and Altitudinal range	Soil/geology	Structure	Species assemblage	Condition thresholds
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Threatened Ecological Community	North Coast, Sydney Basin and South East Corner bioregions	It generally occupies low-lying parts of floodplains, alluvial flats, drainage lines, lake margins and fringes of estuaries; habitats where flooding is periodic and soils show some influence of saline ground water.	Alluvium; silts, clay-loams and sandy loams	The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.	Dominated by a tree canopy of either <i>Casuarina glauca</i> or, more rarely, <i>Melaleuca ericifolia</i> with or without subordinate tree species; the relatively low abundance of Eucalyptus species; and the prominent groundcover of forbs and graminoids. There are 45 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Sydney Basin	Located on alluvial flats and drainage lines on the Georges River floodplain	Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Occurs as a low shrubland or scrub	Dominated by <i>Melaleuca ericifolia</i> mostly without subordinate tree species. Total diagnostic species per plot: <ul style="list-style-type: none"> • Q2 - 4 	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion	Sydney Basin	Located on alluvial flats of the Georges River	Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Occurs as an open forest structure	Tree canopy dominated by <i>Casuarina glauca</i> Total diagnostic species per plot: <ul style="list-style-type: none"> • Q21 - 5 	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.

Threatened ecological community and PCT comparison	Bioregion	Landform and Altitudinal range	Soil/geology	Structure	Species assemblage	Condition thresholds
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Sydney Basin	Associated with alluvial flats and drainage lines associated with Prospect Creek floodplain	Alluvium; silts, clay-loams and sandy loams.	Occurs as an open forest structure	Tree canopy dominated by <i>Casuarina glauca</i> Total diagnostic species per plot: <ul style="list-style-type: none"> • Q20- 2 	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

Figure 3.2
Threatened ecological communities recorded within the study area

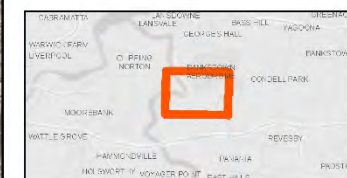


Legend

- Study area
- REF proposal area

Field Verified Vegetation - TEC

- Cocks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – Endangered
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – Endangered
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 15-Jul-21
 Data sources: - NIEARMap, TNHW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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3.6 Groundwater dependent ecosystems

The presence and characteristics of groundwater dependent ecosystems in the study areas is described in this section and illustrated in Figure 3.3.

Groundwater dependant ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater (Department of Land and Water Conservation 2002). When considering GDEs, groundwater is generally defined as the saturated zone of the regolith (the layer of loose rock resting on bedrock, constituting the surface of most land) and its associated capillary fringe, however it excludes soil water held under tension in soil pore spaces (the unsaturated zone or vadose zone) (Eamus, Froend et al. 2006).

GDEs include a diverse range of ecosystems. These ecosystems range from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water) (Hatton and Evans 1998). Eamus *et al.* (2006) considers the following broad classes of these ecosystems:

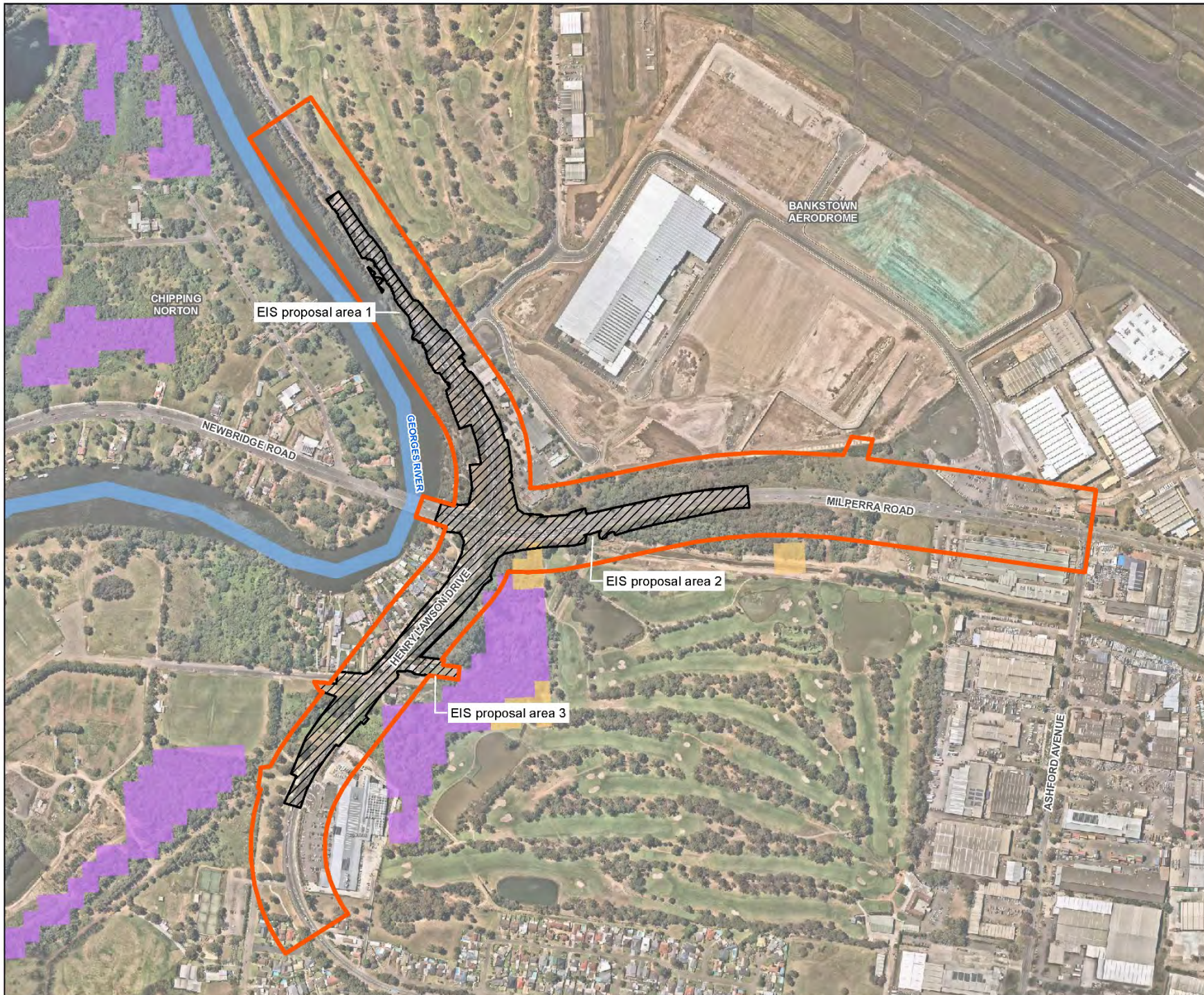
- Aquifer and cave ecosystems, where stygofauna (groundwater-inhabiting organisms) may reside within the groundwater resource. The hyporheic zones of rivers and floodplains are also included in this category because these ecotones often support stygobites (obligate groundwater inhabitants).
- All ecosystems dependent on the surface expression of groundwater. This category includes base-flow rivers and streams, wetlands, some floodplains and mound springs and estuarine seagrass beds. While it is acknowledged that plant roots are generally below ground, this class of groundwater dependant ecosystems requires a surface expression of groundwater, which may, in many cases, then soak below the soil surface and thereby become available to plant roots.
- All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the saturated zone of the water table) when roots penetrate this zone. This class includes terrestrial ecosystems such as River Red Gum (*Eucalyptus camaldulensis*) forests on the Murray–Darling basin. No surface expression of groundwater is required in this class of groundwater dependant ecosystems.

Groundwater levels throughout the overall proposal area are expected to be shallow due to the location on alluvium and the close proximity of the Georges River, between 0 to 8 m below the surface, varying seasonally (higher in winter, lower in summer) (Aurecon, 2021). GDEs which are surface expressions of groundwater within the locality of the study area (<10 km) include the Georges River. Other GDEs which are reliant on subsurface groundwater in the study area include:

- PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 920 - Mangrove Forest in Estuaries of the Sydney Basin and South East Corner
- PCT 1236 - Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

HENRY LAWSON DRIVE STAGE 1A

Figure 3.3
Groundwater dependent ecosystems



Legend

- Study area
- REF proposal area

Ecosystems that rely on the surface expression of groundwater

High potential for groundwater interaction

Ecosystems that rely on subsurface presence of groundwater

- High potential for groundwater interaction
- Moderate potential for groundwater interaction



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 Data sources: - NEARMAP, TNSW, Geoscience Australia, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

3.7 Threatened species and populations

Based on the results of habitat likelihood of occurrence assessments, 58 threatened flora species were known or predicted to occur in the locality, including an additional two endangered populations, of which 17 have been identified as having a moderate or higher likelihood of occurring within the study area (Appendix B). These species became the focus of detailed targeted surveys that have resulted in the identification of two species, *Acacia pubescens* (Downy Acacia) and *Callistemon linearifolius* (Netted Bottle Brush).

In terms of threatened fauna species, the results of habitat likelihood of occurrence assessments identified 94 species as known or predicted to occur in the locality of which 16 have been identified as having a moderate or higher likelihood of occurring within the study area (Appendix B).

An overview of threatened flora and fauna species results are presented in Table 3.23. The location of all recorded threatened species is shown in Figure 3.4.

Table 3.23 Habitat assessment and surveys results

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act ¹	EPBC Act ²			
Flora						
<i>Acacia bynoeana</i>	Bynoes Wattle	E	V	Moderate	No	No - surveyed
<i>Acacia pubescens</i>	Downy Wattle	V	V	Recorded	No	Yes - recorded
<i>Allocasuarina glareicola</i>	-	E2	V	Moderate	No	No - surveyed
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E1	V	Moderate	Yes	No - surveyed
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	Recorded	No	Yes - recorded
<i>Dillwynia tenuifolia</i>	-	V; E2	-	Moderate	No	No - surveyed
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	-	V	-	Moderate	No	No - surveyed
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	V	-	Moderate	No	No - surveyed
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Moderate	No	No - surveyed
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Native Pear	E2	-	Moderate	No	No - surveyed
<i>Pimelea spicata</i>	Spiked Rice-flower	E1	E	Moderate	No	No - surveyed
<i>Pomaderris brunnea</i>	-	E1	V	Moderate	No	No - surveyed
<i>Pultenaea parviflora</i>	-	E1	V	Moderate	No	No - surveyed
<i>Pultenaea pedunculata</i>	Matted Bush-Pea	E1	-	Moderate	No	No - surveyed

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act ¹	EPBC Act ²			
<i>Thesium australe</i>	Austral toadflax	V	V	Moderate	No	No - surveyed
<i>Wahlenbergia multicaulis</i>	Tadgells Bluebell	E2	-	Moderate	No	No-surveyed
<i>Wilsonia backhousei</i>	Narrow-leaved Wilsonia	V	-	Moderate	No	No - surveyed
Fauna						
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	Moderate	No	Yes
<i>Pandion cristatus</i>	Eastern Osprey	V	-	Moderate	No	Yes
<i>Glossopsitta pusilla</i>	Little Loorikeet	V	-	Moderate	No	Yes
<i>Lathamus discolor</i>	Swift Parrot	E1	CE	Moderate	Yes	Yes
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Moderate	No	Yes
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	V	Ma	Moderate	No	Yes
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	V, M, Ma	Moderate	No	Yes
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-	Moderate	No	Yes
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	Moderate	No	Yes
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Moderate	No	Yes
<i>Mormopterus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	-	Moderate	No	Yes
<i>Cercartetus nanus</i>	Eastern Pygmy possum	V	-	Moderate	No	Yes
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Moderate	No	Yes
<i>Myotis macropus</i>	Southern Myotis	V	-	Recorded	No	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	V	-	Moderate	No	Yes
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Moderate	No	Yes

1. Vulnerable (V), Endangered species (E1), Endangered population (E2) Critically Endangered (CE) as listed on the BC Act
2. Vulnerable (V), Endangered (E), Critically Endangered (CE), Migratory (M), Marine (Ma) as listed on the EPBC Act

NOTE: EPBC Migratory species that are not listed as Threatened have not been included in the table, these species have been included in Section 3.7.2 below.

All recorded or potentially occurring threatened biodiversity are discussed further below.

3.7.1 Threatened Flora

Of the 17 candidate threatened flora species identified for the REF proposal, two have been considered as affected species and are outlined in Table 3.23 and discussed in further detail below. Figure 3.4 shows the locations of recorded threatened species.

***Acacia pubescens* (Downy Wattle)**

Twelve individuals of *Acacia pubescens* (Downy Wattle) were recorded within Ashford Reserve along Milperra Road (Photo 3.25). *Acacia pubescens* (Downy Wattle) is listed as vulnerable under both the BC Act and the EPBC Act. During the initial survey period individuals were not identified due to leaf senescence caused by a period of extreme prolonged drought. Current individuals all show signs of recovery post drought in the form of epicormic growth.

This sub-population is known from two locations in the eastern and western portion of the reserve. A dead wattle specimen was observed during the initial survey period in the eastern section of Ashford Reserve that was considered most likely to have been *Acacia pubescens*. This eastern record is dated from 2010 (SICGI0016944) and is accompanied by sighting notes that state it could be a planted specimen.

All individuals identified fall within the study area of the REF proposal.



Photo 3.25 *Acacia pubescens*

***Callistemon linearifolius* (Netted Bottle Brush)**

A small number of specimens were tentatively recorded from alongside Milperra Road roadside verge and within Ashford Reserve in Stage 1A of the study area (Photo 3.26). Given considerable variation was observed in leaf length, width, venation and that no specimens were in flower, plant material was collected and was forwarded to the Royal Botanical Gardens (RBG) herbarium for positive identification. Two samples of *Callistemon* were forwarded to the RBG under enquiry number 20657 and the broad leaf sample was positively identified as *Callistemon linearifolius* - det. Peter G. Wilson, 2nd July 2018 – retained (Appendix D). The second sample, a narrow leaf form was identified as *Callistemon linearis* - det. Peter G. Wilson, 2nd July 2018 – retained.

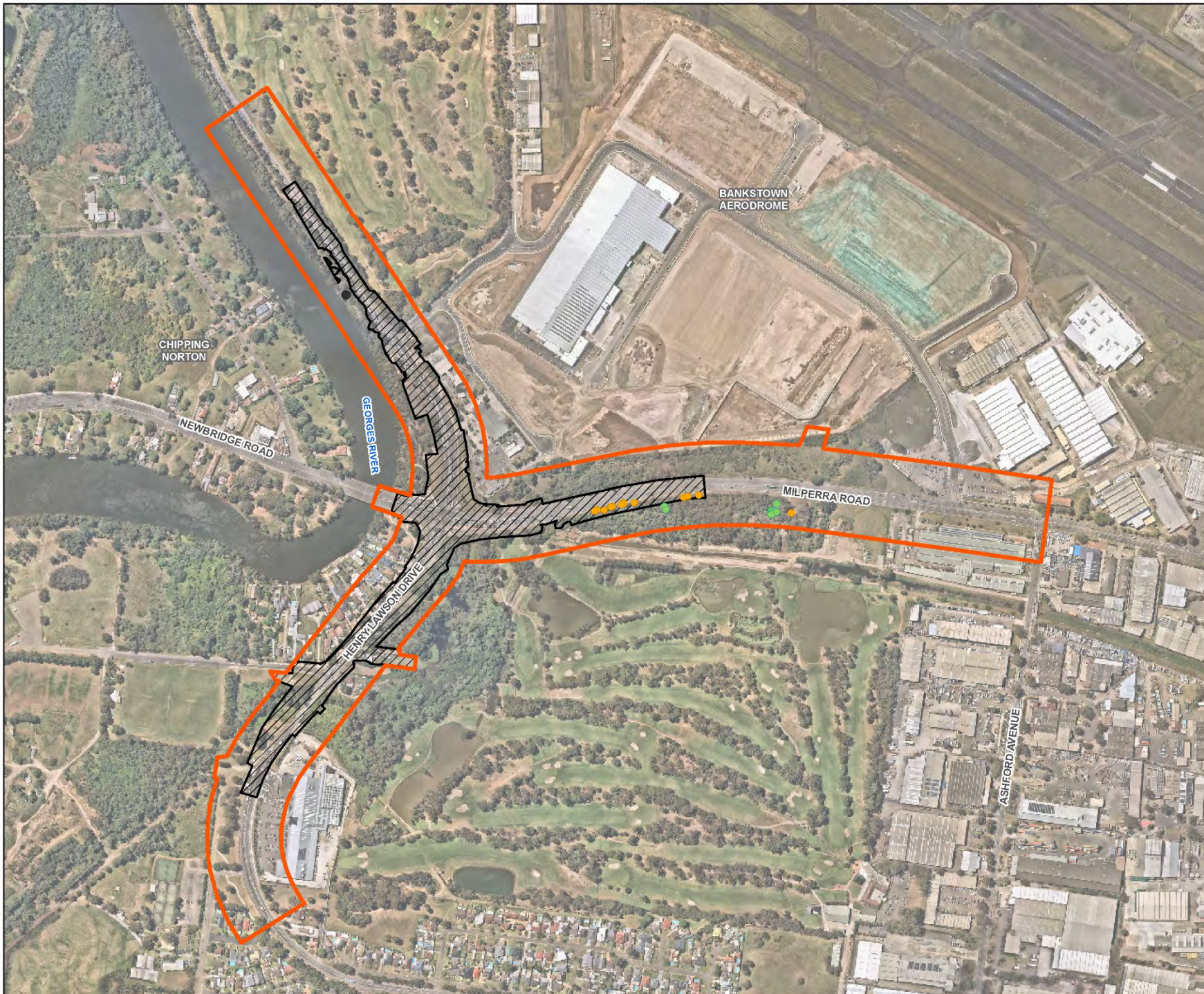
There are four previous records from Ashford Reserve that are all dated 2010 (SICGI0016969, SICGI0016970, SICGI0016972, SICGI0016973). The species sighting notes do not provide any details on whether voucher specimens were lodged for these records.

All identified individuals fall within the study area.



Photo 3.26 *Callistemon linearifolius* within Ashford Reserve Stage 1A

Figure 3.4
Recorded threatened species



Legend

Study area

REF proposal area

Threatened Species

● Microbat roosting culvert (Southern Myotis)

● *Acacia pubescens* - listed as vulnerable on the BC Act and EPBC Act

● *Callistemon linearifolius* - listed as vulnerable on the BC Act



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3.7.2 Threatened Fauna

Green and Golden Bell Frog – *Litoria aurea*

The Green and Golden Bell Frog is distributed along coastal areas of eastern NSW, with most populations small and isolated. The preferred habitat is marshes, lagoons, dams and streams that contain aquatic vegetation of bullrushes (*Typha* spp) and spike rushes (*Eleocharis* spp.). Higher quality habitats consist of waterbodies that are unshaded; have adjacent grassy areas and diurnal shelter sites and are free from predatory Plague Minnow (*Gambusia holbrooki*) fish.

The Green and Golden Bell Frog historically occurred along the majority of the Georges River and associated waterbodies and tributaries (Department of Environment and Climate Change 2008). The Georges River population is known more predominately to occur in the lower reaches of the river system in wetlands at Hammondville, Holsworthy, Prospect Creek and Orphan School Creek (Department of Environment and Climate Change 2008). However, most of these populations are declining and are thought to be either locally extinct or marginally extant (Department of Environment and Energy 2018).

The population of Green and Golden Bell Frogs at Greenacre (near the Intermodal) is about 6-8 kilometres away and was considered locally extinct. Recently surveys conducted by Dr Arthur White confirmed the presence of several Bell Frogs including gravid females, suggesting a small breeding population may still be persisting (Dr Arthur White, *pers comm.*, 28 February, 2021).

Whilst no recent (<10 years) records occur within the study area, potential habitat in the form of artificial wetlands occur within the study area, these habitats exhibit some habitat features (i.e. aquatic vegetation, open water, basking areas etc.) associated with the species.

Targeted surveys were undertaken during December 2018 after a significant rainfall event (>50mm rain). Targeted surveys were undertaken at potential Green and Golden Bell Frog habitat shown in Figure 2.3. Despite targeted surveys, no Green and Golden Bell Frogs were recorded during the survey period. It is considered that the species is unlikely to occur within the habitat in the study area.

Dusky Woodswallow - *Artamus cyanopterus cyanopterus*

Dusky Woodswallows are widespread in eastern, southern and south-western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. They primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and groundcover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.

Dusky Woodswallow is considered to have a moderate likelihood of occurring within the study area due to the presence of potential foraging habitat (open eucalypt forest in the form of Moderate condition PCT 725 and PCT 835). The species has been recorded within the locality (Environment, Energy and Science Group (2020a) but has no records within the study area and was not identified during targeted surveys. Nevertheless, the removal of any native vegetation will cause a reduction in potential foraging habitat for individuals within the locality.

Eastern Osprey - *Pandion cristatus*

Eastern Ospreys are found right around the Australian coastline, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.

Eastern Osprey is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. The species is considered to have a moderate likelihood of occurring within the study area due to

the presence of potential foraging habitat along the Georges River in the west of the study area in the form of Moderate condition PCT 835, PCT920, PCT1234, and PCT1800.

There are several records of the Eastern Osprey occurring within the locality with the most recent record occurring in 2014 (Environment, Energy and Science Group (2020a). The Eastern Osprey was not recorded during targeted species searches. Due to the age of the records within the locality, absence of sightings during field surveys and lack of obvious relevant habitat features (i.e. nests) it is unlikely that Eastern Ospreys are regularly using the study area.

Nectivorous Birds

Little Lorikeet (*Glossopsitta pusilla*) and Swift Parrot (*Lathamus discolor*) have been assessed together due to their shared dependence on the blossom resources of myrtaceous canopy trees and their nomadic habits to access those foraging resources. Both species of bird migrate during different times of year to forage on blossom species across south-eastern Australia. While in some years, individuals can be spoilt for resource choice, there are some years in which blossom availability is relatively low. During those low-blossom seasons small areas of blossom that are flowering can be of great importance to both species.

The study area contains several blossoming trees that represent potential foraging habitat for both the Swift Parrot and Little Lorikeet. There are several records of both species within the locality with the most recent record of the Little Lorikeet occurring in 2016 and of the Swift Parrot in 2014 (Environment, Energy and Science Group (2020a). Neither species was identified during targeted species searches. Any removal of myrtaceous canopy trees will reduce the potential foraging ground for both species. Potential habitat is present in the form of Moderate condition PCT 725 and PCT 835.

Varied Sittella - *Daphoenositta chrysoptera*

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.

Varied Sittella is considered to have a moderate likelihood of occurring within the study area due to the presence of potential habitat (eucalypt forest) and has been recorded within the wider locality with the most recent record in 2017 (Environment, Energy and Science Group (2020a). The study area contains suitable foraging and breeding habitat opportunities for this species. Potential habitat is present in the form of Moderate condition PCT 725 and PCT 835.

White-bellied Sea-eagle – *Haliaeetus leucogaster*

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. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Feed mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion

The White-bellied Sea-eagle was recorded to be foraging offsite during the 2018 survey period. No nests or potential nesting trees were recorded in the study area. Several other records occur in the locality with the most recent in February of 2020 (Environment, Energy and Science Group (2020a) with the note determining it was an actively nesting pair. The removal of native vegetation and alteration of the waterways, especially along the Georges River, has potential to reduce foraging habitat. Potential habitat is present in the form of Moderate condition PCT 835, PCT920, PCT1234, and PCT1800.

White – throated Needletail

Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April. They are more common in coastal areas than inland and are insectivorous. Most often they are seen preceding a weather event that causes insects to swarm and/or causes insects to be lifted into the air.

There are several records within the locality with the most recent record occurring in 2017 (Environment, Energy and Science Group (2020a). However, most of the records occur more than 10 years ago with large gaps of time in between each sighting. The White-throated Needletail may occur over the study area on a seasonal basis, but unlikely to use terrestrial habitats in the study area. Any reduction in native vegetation however would represent a reduction in foraging habitat due to a reduction in insect population that the remaining patches could support. Potential habitat is present in the form of Moderate condition PCT 725 and PCT 835.

Cave-dwelling Microbats

The study area contains culverts and drainage pipes, which are sometimes used by cave-dwelling microbats. Inspection of the culverts showed most culverts had little to no roosting niches for microbats, however Southern Myotis (*Myotis macropus*) were found to be roosting in a culvert in the northern section of the study area (Figure 3.4).

Nevertheless, the study area's forest and woodland habitats provide foraging opportunities for all microbat species, due to the insect populations they attract and support. Two threatened species of microchiropteran bat, Little Bent-winged Bat (*Miniopterus australis*) and the Large Bent-winged Bat (*M. orianae oceanensis*), which occur in the locality, are likely to use the site for foraging on an intermittent basis.

There are also a number of other threatened cave-dwelling bat species, which occur in the wider locality, and although those species may very rarely use the study area for foraging, potential impacts to the study area's wooded habitats would not significantly differ from the impacts to the two Bent-winged Bat species considered the most likely cave-dwelling microbat species to use the site on at least an intermittent basis.

The removal of any vegetation within the study area would represent a reduction in potential foraging habitat for Cave-dwelling microbats. All PCTs provide potential foraging habitat for these species.

Hollow-dwelling Microbats

The study area contains 52 hollow-bearing trees. The trees that contain hollows represent roosting opportunities for hollow-dwelling microbats. Furthermore, the study area's forest and woodland habitats provide foraging opportunities for hollow-dwelling microbat species, due to the insect populations they attract and support. No species of hollow-dwelling microbat was recorded within the study area during onsite surveys conducted by WSP ecologists. Nevertheless, the very occasional use of the study area's habitats by threatened hollow-dwelling microbats cannot be discounted and due to their mobility it is considered likely that such species would occasionally use the study area. The most likely species being *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) and *Micronomus norfolkensis* (Eastern Freetail-bat). Other hollow-dwelling species, for which there is a paucity of records in the vicinity of the site, may rarely use the study area including *Scoteanax rueppellii* (Large Broad-nosed Bat).

The removal of 11 hollow-bearing trees from within the REF proposal area (Figure 3.5), and the removal of any vegetation within the study area, would represent a reduction in potential roosting and foraging habitat for Hollow-dwelling microbats, respectively. All PCTs provide potential foraging habitat for these species.

Grey-headed flying-fox – *Pteropus poliocephalus*

Grey-headed Flying-foxes are generally found within 200km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. 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 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Can travel up to 50km from the camp to forage; commuting distances are more often <20km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.

A Grey-headed Flying-fox was recorded offsite during the 2018 survey period and there are numerous records within the locality. The study area does not contain suitable habitat for roosting camps and such habitat does not occur within its close vicinity. It does contain potential foraging in the form of flowering tree species. The removal of any flowering tree species would represent a reduction in foraging habitat. Potential habitat is present in the form of Moderate condition PCT 725 and PCT 835.

Eastern Pygmy-possum – Cercartetus nanus

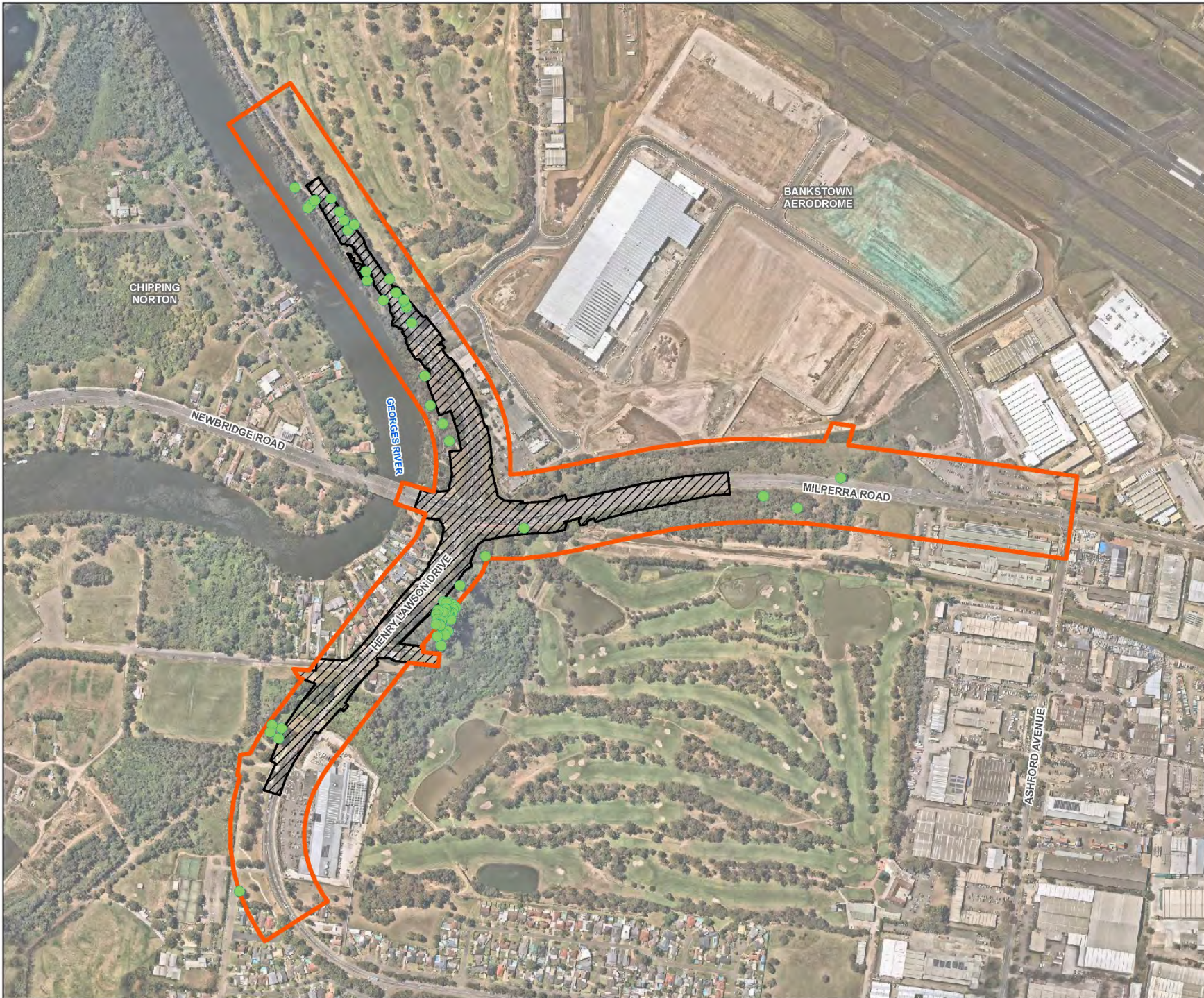
The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.

No Eastern Pygmy-possums were observed on site during targeted species searches. While there are a few records within the locality, the fragmentation and isolation of the study area may not make it an optimal habitat patch.

Cumberland Plain Land Snail

The Cumberland Plain Land Snail occupies small areas Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. It is associated with Cumberland Plain Woodland, which is a grassy, open woodland with occasional dense patches of shrubs. The species is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. The species lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps (NSW National Parks and Wildlife Service 1999, Office of Environment & Heritage 2018). There are recent (<3 years) records within the locality (Office of Environment & Heritage 2018). The species may also utilise other vegetation areas where intact native vegetation occurs and important microhabitat features are present (i.e. leaf litter, fallen timber and grasses). However, the species was not identified in the study area.

Figure 3.5
Hollow bearing tree locations



Legend

- Hollow-bearing tree
- Study area
- REF proposal area



Coordinate system: GDA 1994 MGA Zone 56

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Data sources: - NEARMAP, NSW Geoscience Australia
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3.8 Aquatic habitat

The Georges River is a drowned river valley with a catchment that drains over 790 km² south west of Sydney and contributes the majority of flow into Botany Bay. The catchment includes reasonably intact areas of bushland and areas of substantial urbanisation and development. The river is approximately 221 km long with an average water depth of 10.5 m. The Liverpool Weir, built in 1830s, marks the tidal limit approximately 49 km from the river mouth.

The study area lies entirely in the Lower Georges River where approximately two thirds of the 439 km² catchment has been largely cleared and developed. The southern tributaries flow through forested subcatchments in Dharawal Nature Reserve and Holsworthy Military Reserve and include Harris Creek, Williams Creek and Deadman's Creek. These creeks are in good condition; whilst the northwestern (left bank) tributaries are somewhat degraded as they drain extensively cleared and highly modified catchments. These waterways include Hinchinbrook Creek, Cabramatta Creek, Clear Paddock Creek, Orphan School Creek and Prospect Creek.

All river and creek reaches within the REF proposal area are tidal and hence are considered estuarine. Other waterbodies and wetlands in the study area include a series of small wetlands along the northern and western perimeter of Bankstown Golf Club, bounded by Henry Lawson Drive to the west and Milperra Road to the north, and Milperra Drain which drains the golf course, flowing westward under Henry Lawson Drive to the border of Gordon Parker Reserve, Milperra.

3.8.1 Habitat condition

The condition of the aquatic habitat was assessed based on the results of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman et al., 1997). This assessment involved evaluation and scoring of the characteristics of the adjacent land, the condition of riverbanks, channel and bed of the watercourse and degree of disturbance evident at each site. The maximum score (52) indicates a stream with little or no obvious physical disruption and the lowest score (13) indicates a heavily channelled stream without any riparian vegetation and can be considered to be in poor condition.

A summary of the RCE results is provided in Table 3.24. The waterways at all surveyed habitat assessment sites were in moderate condition (RCE scores varying from 29 to 38) with the scores largely driven by relatively wide riparian zones composed of native and exotic trees and shrubs, fully stabilised banks, medium to deep channel form (apart from artificial waterways), and little channel sediment accumulation.

Photos of the waterways at each survey site are provided in Photo 3.27 to Photo 3.50.

Table 3.24 Summary of RCE results

Aquatic survey site	Overall RCE score (out of 52)	Aquatic habitat condition
Aquatic Site 1	37	Moderate
Aquatic Site 2	34	Moderate
Aquatic Site 3	32	Moderate
Aquatic Site 4	34	Moderate
Aquatic Site 5	37	Moderate
Aquatic Site 6	33	Moderate
Aquatic Site 7	33	Moderate
Aquatic Site 8	33	Moderate
Aquatic Site 9	29	Moderate
Aquatic Site 10	30	Moderate
Aquatic Site 11	38	Moderate
Aquatic Site 12	35	Moderate

3.8.2 Key Fish Habitat

The Georges River is the only mapped Key Fish Habitat within the study area and has a waterway classification of Class 1: Major key fish habitat with habitat sensitivity Type 2: Moderately sensitive key fish habitat as defined in the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013). This is due to the Georges River being a permanently flowing estuarine waterway. This Key Fish Habitat is mapped in Figure 3.6. The mapped Key Fish Habitat of the Georges River is outside of the REF proposal area.

The Milperra Drain, which drains the Bankstown golf course, flowing westward under Henry Lawson Drive to the border of Gordon Parker Reserve in Milperra, is not mapped Key Fish Habitat. Based on the definition of Key Fish Habitat provided by DPI Fisheries (NSW Department of Primary Industries Fisheries, 2021), urban drains such as Milperra Drain are not included in Key Fish Habitat.

3.8.3 Riparian areas

In the study area the banks of the Georges River are lined by seedlings, shrubs and trees of River mangroves (*Aegiceras corniculatum*) and Grey mangroves (*Avicennia marina*) (PCT 920). This observation confirmed the broad-scale map of mangrove distribution in the waterways.

Fringing mangroves were mixed with and backed by Swamp oaks (*Casuarina glauca*) (PCT 1234), Forest Red Gum-Rough-barked Apple Grassy Woodland community (PCT 835, Forest Red gum and Blue Box variants) and a variety of weeds and exotic plants and shrubs. This vegetation mosaic dominated both banks of the Georges River, with discontinuities where residences or commercial or recreational developments backed onto the river front. For most its length, the riparian zone along the eastern bank of the Georges River includes a shared pathway. Its average width is 33 m with a range of 19 m to 47 m wide. The banks near the boat ramp at Rabaul Rd and behind some residences and developments have been reinforced with rock.

3.8.4 Threatened fish species

Based on the review of the Fisheries Spatial Data Portal (freshwater threatened species maps), the freshwater fish community of the Georges River is rated as Good (based on data derived from fish sampling records 2009 – 2011). Habitat for threatened freshwater fish is not mapped in the Georges River. Threatened fish species returned from the PMST search including Macquarie Perch and Black Rockcod are not known to occur in the study area.



Photo 3.27 Aquatic Site 1 - Georges River looking north from the Newbridge Road bridge showing riparian zone



Photo 3.28 Aquatic Site 1 - Georges River looking west from the cycle path adjacent to the Newbridge Road Bridge



Photo 3.29 Aquatic Site 1 - Georges River looking north west from the Newbridge Road bridge



Photo 3.30 Aquatic Site 2 - Georges River looking south west from the cycle path back to the Newbridge Road bridge showing riparian zone



Photo 3.31 Aquatic Site 3 - The unnamed stream that exits Georges River Golf Course showing the culvert and riparian zone on the western side of Henry Lawson Drive



Photo 3.32 Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive



Photo 3.33 Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive showing culvert



Photo 3.34 Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive showing water clarity



Photo 3.35 Aquatic Site 11 - The unnamed second order stream at the Auld Avenue bridge showing riparian zone



Photo 3.36 Aquatic Site 11 - The unnamed second order stream at the Auld Avenue bridge showing water clarity



Photo 3.37 Aquatic Site 12 - The unnamed stream upstream of the Auld Avenue bridge showing riparian zone



Photo 3.38 Aquatic Site 5 - The unnamed stream and culvert on the northern side of Milperra Road



Photo 3.39 Aquatic Site 5 - Inside the culvert under Milperra Road showing the unnamed first order stream which drains south to the Milperra Drain



Photo 3.40 Aquatic Site 5 - The unnamed first order stream on the northern side of Milperra Road which drains south to the Milperra Drain showing water clarity



Photo 3.41 Aquatic Site 5 - The unnamed first order stream on the northern side of Milperra Road showing riparian zone



Photo 3.42 Aquatic Site 8 - The unnamed first order stream on the southern side of Milperra Road showing riparian zone



Photo 3.43 Aquatic Site 8 - The unnamed stream on the southern side of Milperra Road showing mapped Coastal Wetland



Photo 3.44 Aquatic Site 6 - The unnamed stream in the east of the study area on the northern side of Milperra Road showing the culvert



Photo 3.45 Aquatic Site 6 - The unnamed first order stream in the east of the study area on the northern side of Milperra Road



Photo 3.46 Aquatic Site 6 - The unnamed first order stream in the east of the study area showing inside the culvert



Photo 3.47 Aquatic Site 7 - The unnamed first order stream in the east of the study area on the southern side of Milperra Road



Photo 3.48 Aquatic Site 9 - A stormwater drain on the southern side of Milperra Road showing the riparian zone

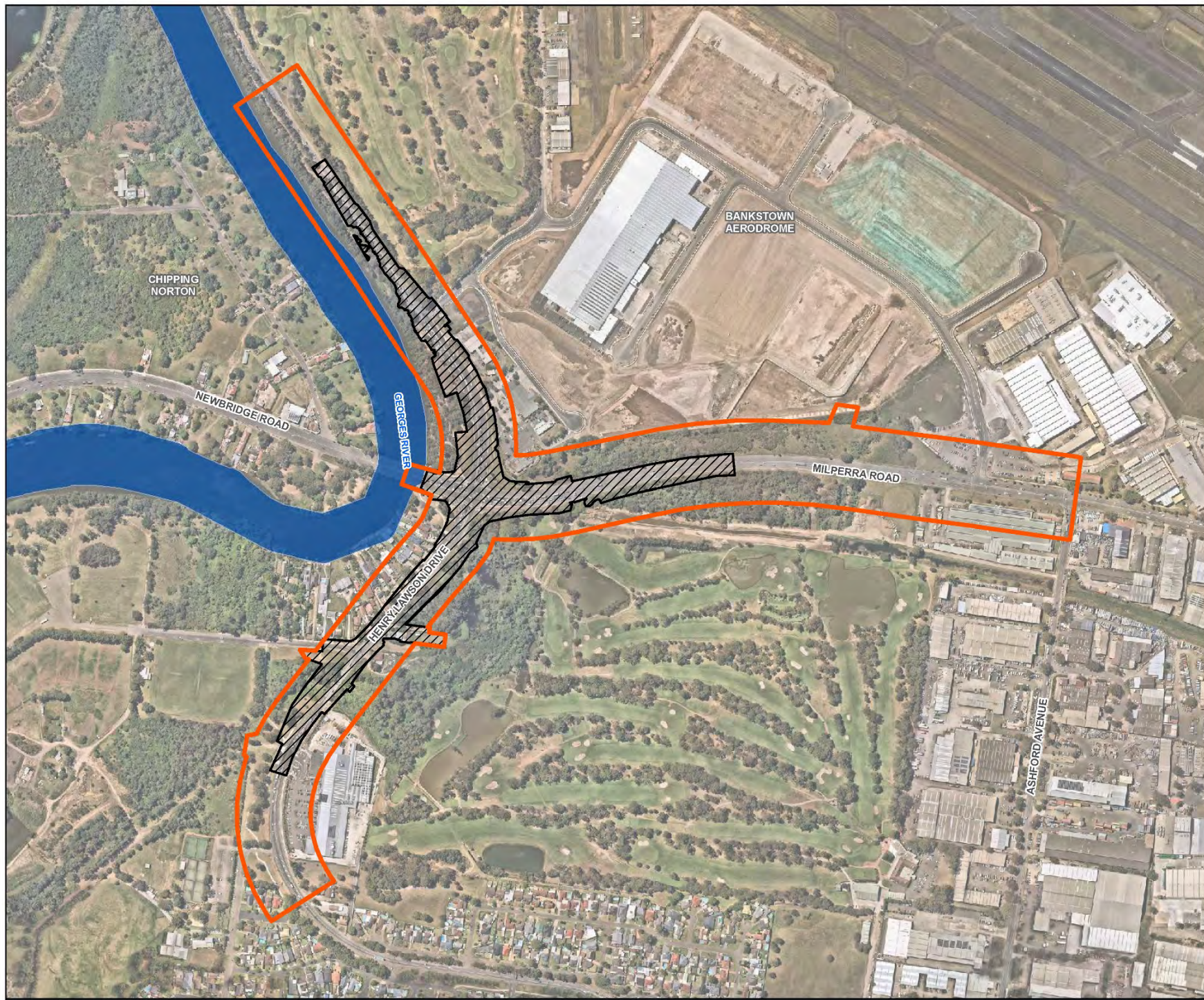


Photo 3.49 Aquatic Site 9 - A stormwater drain on the southern side of Milperra Road showing the pipe exit

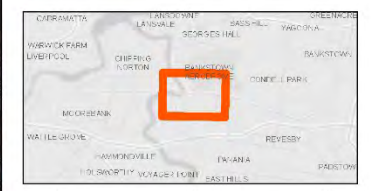


Photo 3.50 Aquatic Site 10 - A stormwater drain on the eastern side of Henry Lawson Drive showing macrophytes

Figure 3.6
Key Fish Habitat mapping



- Legend**
- Study area
 - REF proposal area
 - Key Fish Habitat



0 0.5 1.0 km

Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 21/04/21

Data sources - NEARmap, NSW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
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3.9 Critical habitat

The registers of critical habitat listed under the EPBC Act, BC Act and FM Act searched during the desktop analysis and no critical habitat was found to occur within or in the locality of the study area.

3.10 Wildlife connectivity corridors

Wildlife corridors are generally links of native vegetation that join two or more areas of similar habitat and are critical for sustaining ecological processes, such as provision for animal movement and the maintenance of viable populations (Department of Environment, 2016). The removal of native vegetation and splitting of habitat patches can result in habitat fragmentation which is to 'physical dividing up of once continuous habitats into separate smaller 'fragments'' (Fahrig, 2002). The REF proposal is considered unlikely to result in a large increase to landscape scale fragmentation and to further limit connectivity and movement corridors than what already exists in the study area, as it largely follows existing roadways. The impacts from the REF proposal would largely involve 'trimming' the edges of vegetation patches adjacent to the existing road corridor, which would not result in additional habitat fragmentation.

The REF proposal is however likely to result in a reduction in vegetation patch sizes resulting in minor increases in localised fragmentation of the regional wildlife patches along the Georges River. Due to the importance of connectivity, dispersal opportunities and habitat quality for species at a local scale, this impact has the potential to be negative to the dispersal of relatively sedentary species such as mammals, frogs, and reptiles. However, due to the disturbed, urban setting of the REF proposal, most if not all native animal species which are sensitive to habitat fragmentation and predation (e.g. native ground-dwelling mammals, arboreal mammals (except for adaptable common possum species) and monitor lizards) are likely to have already been lost from the habitats in the study area. Mobile species such as birds and bats are unlikely to be affected by this fragmentation as the landscape in which they currently exist is fragmented and the predicted level of fragmentation would not be enough to restrict their dispersal between habitat patches.

The predicted level of fragmentation from the REF proposal is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. The existing functional connectivity for many species would remain in the study area.

3.11 NSW State Environmental Planning Policy's

There are two NSW State Environmental Planning Policy's (SEPPs) that relate to biodiversity that are considered for the study area. These are:

- SEPP (Coastal Management) 2018
- SEPP (Koala Habitat Protection) 2019.

An overview of each SEPP and the relevance to the study area is provided below.

3.11.1 SEPP (Coastal Management) 2018

The State Environmental Planning Policy Coastal Management 2018 (Coastal Management SEPP) was introduced to provide an integrated policy for coastal assets. Under the Coastal Management SEPP, areas of 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' have been mapped across the state.

The study area occurs within and immediately adjacent to areas mapped as 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' as determined by the Coastal Management SEPP. An overview of the extent of these wetlands and the current REF study area and REF proposal area is provided in Table 3.25 and Figure 3.7.

Table 3.25 SEPP Coastal management areas

Location	Area of Coastal Wetland (ha)	Area of Wetland 100 m buffer zone (ha)
Study area	1.3	19.34
REF proposal area	0	7.10

Coastal wetlands and buffer zones occur within the study area and the REF proposal area will impact on about 7.10 hectares of Proximity Coastal Wetlands (100 metre buffer). The REF proposal incorporates the majority of the overall proposal, however, excludes works which are located within the SEPP (Coastal Management) area.

3.11.2 SEPP (Koala Habitat Protection)

The Koala Habitat Protection SEPP came into effect on 1 March 2020. The SEPP is not relevant to Part 5.1 developments although the intentions of the SEPP are considered for this BAR.

3.12 Regional Environmental Plans and Development Control Plans

3.12.1 Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (1999 EPI 52)

The Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (1999 EPI 52) applies to specific LGAs that occur within the Georges River catchment. The aims of this plan are to:

- Maintain and improve water quality and river flows of the Georges River and its tributaries
- Protect and enhance the environmental quality of the Catchment for the benefit of all users
- Ensure consistency and local environment plans and also in the delivery of the principles of ecologically sustainable development in the assessment of development within the catchment where there is potential to impact adversely on groundwater and on the water quality and river flows within the Georges River
- To establish a consistent and co-ordinated approach to environmental planning and assessment for land along the Georges River and its tributaries and to promote integrated catchment management policies and programs in the planning and management of the catchment
- To provide a mechanism that assists in achieving the water quality objects and river flow objectives agreed under the Water Reform Package.

The REF proposal occurs within the City of Canterbury Bankstown LGA which is identified in Part 1 of the plan as an LGA in which the plan applies. As the REF proposal would involve indirect impact to wetlands, alter stormwater run-off and disturb the Georges River foreshore, Part 2 of the plan applies.

Part 3 of the plan requires that any public authority undertaking works that may significantly affect the water quality and flows of Georges River its tributaries and the environment within the catchment must undertake the controls set out in the LEP of the local council.

The REF proposal may result in a reduction in water quality and increase surface run-off entering the Georges River catchment because of an increase in impervious surfaces. Furthermore, excavations of subsurface soil may result in the mobilisation of potential contaminants. The REF proposal area is in proximity of potential sources to these contaminants.

3.12.2 Bankstown Development Control Plan (2015)

Part B 11 Tree Management Order

The objectives of the tree management order is to retain trees in the urban environment as they provide ecological, environmental, social, health, heritage and amenity values. Trees maintain and enhance biodiversity and natural ecosystems and processes.

The concept design for the REF proposal would involve the removal of native and exotic trees as part of the impacts of the road upgrade. These trees provide habitat for a number of threatened fauna species including 11 hollow-bearing trees which occur in the REF proposal area.

Where practicable, trees would be retained as part of the REF proposal. Removal of all trees would use best practice methods outlined in the Biodiversity Guidelines: protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011).

Native trees that are representative of the vegetation removed would be replanted in areas that were previously cleared for temporary disturbed areas, such as ancillary sites where practicable. Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects (Roads and Traffic Authority, 2011) and Landscaping Plans prepared as part of the proposal's urban design. This biodiversity assessment has informed the development of the concept design Landscaping Plans. Further information can be found in the proposal's Urban Design Report by Tract (2021).

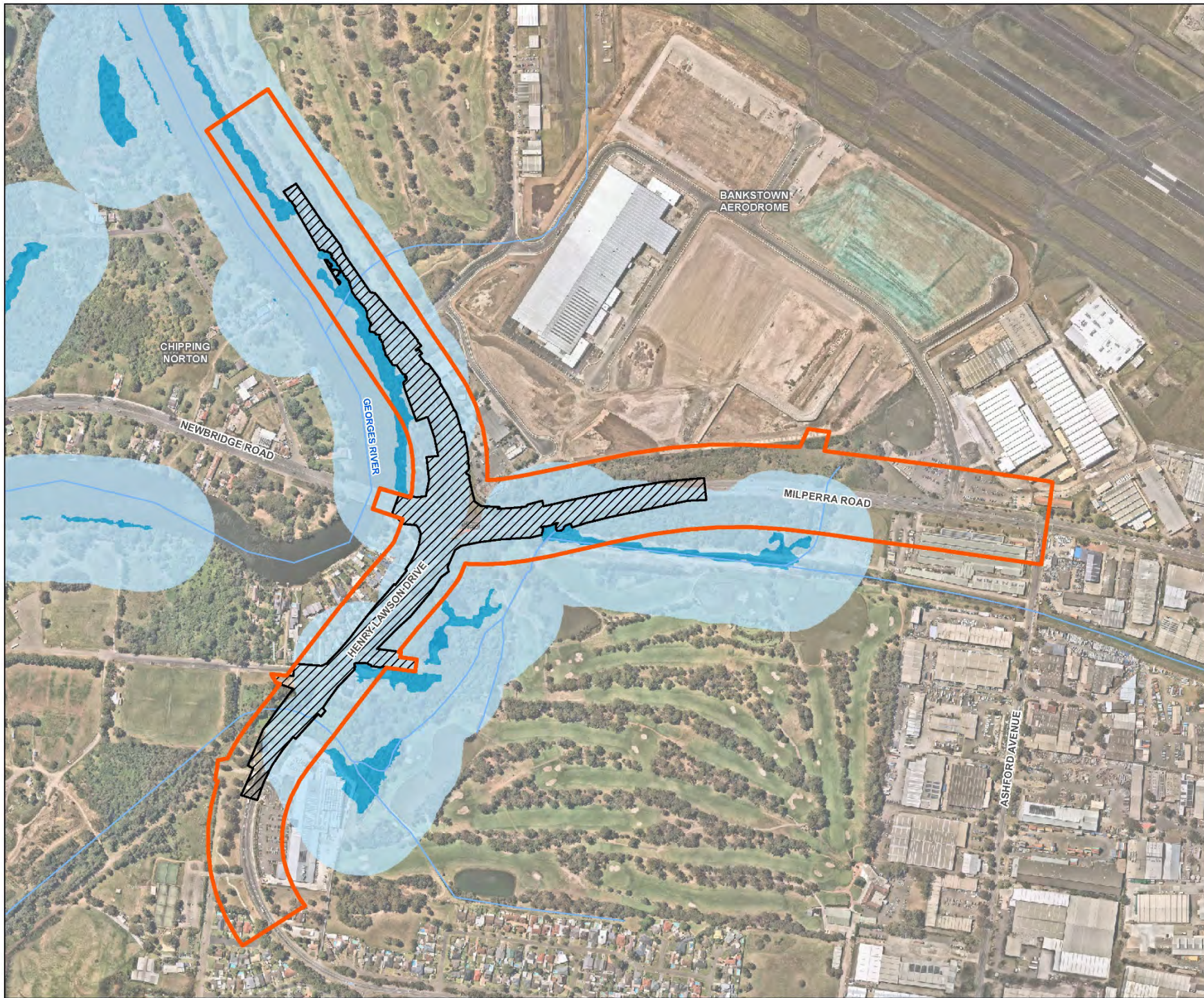
Part B12 Flood Risk Management

This part of the Bankstown Development Control Plan (DCP) aims to reduce the risk of human life and damage to property caused by flooding. Areas of the City of Canterbury Bankstown LGA have been mapped according to their risk of flooding.

The REF proposal area is mapped as at high risk of flooding and below the 100-year flood level defined in this DCP. The REF proposal area is subject to flooding due to its proximity to the Georges River.

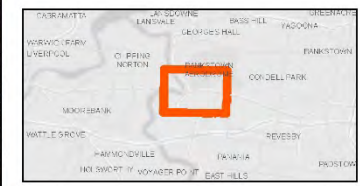
The stormwater design for operational phase would aim to maintain, wherever possible, the existing flood regime and levels as identified by Lyall & Associates (2018). Upgrading of transverse drainage along Henry Lawson Drive, upgrade of existing stormwater drainage system and raising of Henry Lawson Drive in strategic locations is recommended (Lyall & Associates, 2018).

Figure 3.7
NSW State Environmental
Planning Policy (Coastal
Management) 2018 Map



Legend

- Watercourse
- Study area
- REF proposal area
- Coastal wetlands**
- Coastal wetland (only wetlands within vicinity of footprint shown)
- 100m buffer zone



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 15-Jul-21
 Data sources: - NEARMAP, TNSW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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3.13 Matters of National Environmental Significance

Matters of National Environmental Significance (MNES), listed under the EPBC Act, are addressed in this section. The following biodiversity MNES protected under the EPBC Act were considered for their relevance to the REF proposal:

- wetlands of international importance (Ramsar) (EPBC Act sections 16 and 17B)
- listed threatened species and communities (EPBC Act sections 18 and 18A)
- listed migratory species (EPBC Act sections 20 and 20A).

3.13.1 Wetlands of International Importance

One wetland of international importance (Ramsar) occurs within 10km of the study area which is the Towra Point Nature Reserve. Towra Point Nature Reserve lies on the northern side of Kurnell Peninsula, forming the southern and eastern shores of Botany Bay. As such, given the distance of the REF proposal from Towra Point Nature Reserve there will not be any direct impact from the REF proposal and indirect downstream impacts are also predicted to be negligible (see impacts to aquatic habitat discussed in Section 4.1.4). The REF proposal is unlikely to impact any wetlands of international importance.

3.13.2 Threatened Ecological Communities

Results of the protected matters database search identified 11 TECs listed under the EPBC Act as being likely to occur within the locality as follows:

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Coastal Upland Swamps in the Sydney Basin Bioregion
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion
- Subtropical and Temperate Coastal Saltmarsh
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion
- Western Sydney Dry Rainforest and Moist Woodland on Shale.

Of these 11 TECs, the study area contains vegetation corresponding to three EPBC Act listed TECs (see Table 3.26):

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

An examination of the vegetation within the study area compared to the key diagnostic characteristics and condition thresholds for the three TECs identified above is presented in the following sections.

Table 3.26 A summary of threatened ecological communities listed under the EPBC Act recorded within the study area

Threatened ecological community	Status	Associated PCT and vegetation zone within the study area	Extent in study area (ha)
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community	E	VZ12 – PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition	1.32
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE	VZ1 – PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition	2.33
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CE	VZ3 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)	2.32
		VZ4 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	0.64
Total			6.61

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community.

Within the study area the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community corresponds directly to the following PCTs:

- PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion
- PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

The location of the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community is illustrated in Figure 3.8.

To be considered part of the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community the vegetation within the study area must meet the description of the TEC provided in the *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Department of the Environment and Energy, 2018) and the vegetation must meet both the key diagnostic characteristics and at least the minimum condition thresholds for Category C. Provided that the patch meets the key diagnostic characteristics and condition thresholds, revegetated or replanted sites or areas of regrowth are not excluded from the listed ecological community (Department of the Environment and Energy, 2018).

Key diagnostic characteristics

An overview of key diagnostic characteristics for the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community as outlined by the Department of the Environment and Energy (2018), against the candidate PCTs from within the study area is presented in Table 3.27.

From the examination of key diagnostic characteristics, PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion, a PCT that may have potentially corresponded to this TEC has been excluded. The remaining PCTs: PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin

and South East Corner Bioregion, and PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley, meet the key diagnostic characteristics for this TEC.

Table 3.27 Comparison of Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community key diagnostics against candidate PCTs (Department of the Environment and Energy, 2018)

Key diagnostic characteristic	PCT 1234	PCT 1236	PCT 1800
Occurs from south-east Queensland to southern NSW within the South-Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions	Yes Sydney Basin	Yes Sydney Basin	Yes Sydney Basin
Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.	Yes Associated with alluvial flats and drainage lines (<50m) associated with the Georges River floodplain	Yes Located on alluvial flats and drainage lines (< 50m) on the Georges River floodplain	Yes Located on alluvial flats (< 50m) of the Georges River
Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates.	Yes Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Yes Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Yes Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain
Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover of at least 10 per cent.	Yes Occurs as an open forest structure	No Occurs as a low shrubland	Yes Occurs as an open forest structure
Has a canopy of trees dominated by <i>Casuarina glauca</i> (swamp-oak, swamp she-oak).	Yes Tree canopy dominated by <i>Casuarina glauca</i>	No Dominated by <i>Melaleuca ericifolia</i>	Yes Tree canopy dominated by <i>Casuarina glauca</i>
Comparison	Meets key diagnostic characteristics	Does not meet key diagnostic characteristics	Meets key diagnostic characteristics

Condition thresholds

Condition thresholds are intended to function as a set of criteria that assists in identifying when the EPBC Act is likely to apply to an ecological community and provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a MNES, as defined under the EPBC Act. The condition thresholds for the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community as taken from the *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Department of the Environment and Energy, 2018) are presented in Table 3.28.

A patch of the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community is defined a discrete and mostly continuous area of the ecological community, as defined by the key diagnostics, but can include small-scale variations, gaps and disturbances (Department of the Environment and Energy, 2018). The edge of the patch extends to the outer edge of swamp oak tree canopy. Where the canopy is sparse or interrupted, the edge of the patch is defined by the shortest distance between the outer edges of the canopies of each of the outermost trees (Department of the Environment

and Energy, 2018). When it comes to defining a patch of the ecological community allowances are made for “breaks” up to 30 metres wide between areas that meet the key diagnostic characteristics (Department of the Environment and Energy, 2018). These breaks may be the result of watercourses or drainage lines, tracks, paths, roads, gaps made by exposed areas of soil, and areas of localised variation in vegetation that do not meet the key diagnostics (Department of the Environment and Energy, 2018). Based on this definition of a patch, there would be six separate patches of *Casuarina glauca* dominated vegetation that meet the key diagnostic characteristics of the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (this excludes areas of PCT 1236).

There is one patch of PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion located along the edge of the Georges River and Henry Lawson Drive that meets the minimum patch size threshold to be considered part of the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (see Figure 3.8). This patch is about 2.11 ha in size. The remaining identified patches of *Casuarina glauca* dominated vegetation that meet the key diagnostic characteristics of the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community are too small to meet the minimum 0.5 ha condition threshold.

Plot data collected from this larger patch and random meander survey indicated that the patch quality is variable but would meet moderate quality – Category C as outlined in Table 3.28. This is based on the patch exhibiting some native understorey, non-native species comprise <80% cover and transformer weeds are <50% of the total understorey cover.

Table 3.28 Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community minimum condition thresholds (Department of the Environment and Energy, 2018)

<p>Condition thresholds</p> <p>Patch size classes →</p> <p>↓ Vegetation quality classes</p>	<p>Large patch The patch is at least 5 ha</p>	<p>Medium patch The patch is at least 2 ha and less than 5 ha</p>	<p>Small contiguous** The patch is at least 0.5 ha and less than 2 ha, and is connected to a larger area of native vegetation of at least 5 ha</p>	<p>Small patch The patch is at least 0.5 ha and less than 2 ha</p>
<p>HIGH QUALITY Predominantly native understorey Non-native species comprise less than 20% of total understorey vegetation cover*</p>	<p>CATEGORY A A <u>large patch</u> that meets key diagnostics and has a <u>predominantly native understorey</u></p>	<p>CATEGORY B A <u>medium patch</u> that meets key diagnostics and has a <u>predominantly native understorey</u> OR A <u>small patch</u> that meets key diagnostics and has a <u>predominantly native understorey</u> and is <u>contiguous**</u> with another <u>large area of native vegetation</u></p>		<p>CATEGORY C A <u>small patch</u> that meets key diagnostics and has a <u>predominantly native understorey</u></p>
<p>GOOD QUALITY Mostly native understorey Non-native species comprise less than 50% of total understorey vegetation cover* AND transformer species*** comprise less than 30% of total understorey vegetation cover*</p>	<p>CATEGORY B A <u>large patch</u> that meets key diagnostics and has a <u>mostly native understorey</u></p>	<p>CATEGORY C A <u>medium patch</u> that meets key diagnostics and has a <u>mostly native understorey</u> OR A <u>small patch</u> that meets key diagnostics and has a <u>mostly native understorey</u> and is <u>contiguous**</u> with another <u>large area of native vegetation</u></p>		
<p>MODERATE QUALITY Some native understorey Non-native species comprise less than 80% of total understorey vegetation cover* AND transformer species*** comprise less than 50% of total understorey vegetation cover*</p>	<p>CATEGORY C A <u>large or medium patch</u> that meets key diagnostics and has <u>some native understorey</u></p>			
<p>*Refers to total perennial understorey vegetation cover for the patch of the ecological community. Includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil. Areas of little to no understorey vegetation cover (e.g. plant litter) are included if key diagnostics are met and non-native species are below thresholds.</p> <p>**Contiguous means the patch is connected or in close proximity (within 30 m) to another area of native vegetation.</p> <p>***Transformer species (e.g. <i>Chrysanthemoides monilifera</i>, <i>Asparagus</i> spp, <i>Pennisetum</i> spp, <i>Ipomoea</i> spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community. See p. 43 for further information on weeds, including transformer species. Annual weeds, such as <i>Symphytotrichum subulatum</i> (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not be counted as transformer weeds in determining condition.</p>				

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC occurs in the study area and is associated with PCT 725: Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (see Figure 3.8). This vegetation type was recorded in two condition classes being moderate (VZ1) and poor (VZ1a).

To be considered part of the EPBC Act listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC the vegetation within the study area must meet the description of the TEC provided in the *Approved Conservation Advice (including listing advice) for Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion* (Department of the Environment, 2015). The vegetation must also meet the key diagnostic characteristics and condition thresholds.

Key diagnostic characteristics

An overview of key diagnostic characteristics for the EPBC Act listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC as outlined by the Department of the Environment (2015), against the candidate PCTs from within the study area is presented in Table 3.29.

From the examination of key diagnostic characteristics, PCT 725: Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion within the study area meets the key diagnostic characteristics for this TEC.

Table 3.29 Comparison of Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC key diagnostics against PCT 725 from within the study area (Department of the Environment, 2015)

Key diagnostic characteristic	PCT 725
Confined to the Sydney Basin Bioregion	Yes Located in the Sydney Basin
Primarily occurs in w 100 m above sea level	Yes Occurs below 100 m above sea level
Occurs in the Cumberland Subregion with clay soils derived from predominantly Tertiary alluvium and on Wianamatta Shale derived soils found next to Tertiary alluvium (in eastern areas of the ecological community's distribution, a sandstone influence is evident)	Yes Occurs in the Cumberland Subregion with clay soils derived from predominantly Tertiary alluvium and on Wianamatta Shale derived soils found next to Tertiary alluvium
Is a dry sclerophyll open-forest to low woodland typically dominated by an overstorey of <i>Eucalyptus fibrosa</i> and <i>Melaleuca decora</i> , with <i>Eucalyptus longifolia</i> also often present	Yes It is a dry sclerophyll open-forest to low woodland dominated by an overstorey of <i>Eucalyptus fibrosa</i> and <i>Melaleuca decora</i> , with <i>Eucalyptus longifolia</i> also present
Usually includes a moderate to dense mid/shrub stratum, commonly including <i>Melaleuca nodosa</i> and <i>Lissanthe strigosa</i> , and to a lesser extent <i>Melaleuca decora</i>	Yes includes a moderate to dense mid/shrub stratum, commonly including <i>Melaleuca nodosa</i> and to a lesser extent <i>Melaleuca decora</i>
The ground layer is variable and generally sparse with a mix of grasses and other graminoids, forbs, and low shrubs	Yes The ground layer is variable and generally sparse with a mix of grasses and other graminoids, forbs, and low shrubs

Key diagnostic characteristic	PCT 725
Patches typically contain many of the plant species presented at Table A1 (Appendix A) and may contain fauna species presented in Section 1.4	<p>Yes</p> <p>The patches contain many of the plant species presented at Table A1 (Appendix A) including <i>Acacia decurrens</i>, <i>Acacia falcata</i>, <i>Acacia pubescens</i>, <i>Allocasuarina littoralis</i>, <i>Angophora floribunda</i>, <i>Aristida vagans</i>, <i>Astroloma humifusum</i>, <i>Bursaria spinosa</i>, <i>Brunoniella australis</i>, <i>Cheilanthes sieberi</i>, <i>Cassytha glabella</i>, <i>Dianella longifolia</i>, <i>Dichondra repens</i>, <i>Echinopogon caespitosus</i>, <i>Entolasia stricta</i>, <i>Eragrostis brownii</i>, <i>Eucalyptus fibrosa</i>, <i>Eucalyptus longifolia</i>, <i>Glycine clandestina</i>, <i>Glycine tabacina</i>, <i>Hakea sericea</i>, <i>Hibbertia aspera</i>, <i>Kunzea ambigua</i>, <i>Laxmannia gracilis</i>, <i>Lepidosperma laterale</i>, <i>Leucopogon juniperinus</i>, <i>Lobelia purpurascens</i>, <i>Lomandra filiformis</i>,</p> <p><i>Lomandra longifolia</i>, <i>Lomandra multiflora</i>, <i>Melaleuca decora</i>, <i>Melaleuca nodosa</i>, <i>Microlaena stipoides</i>, <i>Notelaea longifolia</i>, <i>Oxalis perennans</i>, <i>Ozothamnus diosmifolius</i>, <i>Paspalidium distans</i>, <i>Pimelea linifolia</i>, <i>Pultenaea villosa</i>, and <i>Veronica plebeia</i></p>
Comparison	Meets key diagnostic characteristics

Condition thresholds

Condition thresholds are intended to function as a set of criteria that assists in identifying when the EPBC Act is likely to apply to an ecological community and provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a MNES, as defined under the EPBC Act. The condition thresholds for the EPBC Act listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC as outlined by the Department of the Environment (2015), are presented in Table 3.30.

For Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion, categories A and B are considered a moderate quality condition class and the minimum thresholds for a patch of the ecological community to be subject to the referral, assessment and compliance provisions of the EPBC Act (Department of the Environment, 2015).

A patch of the Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion TEC is defined a discrete and mostly continuous area of the ecological community (Department of the Environment, 2015). Patches can be spatially variable and often there are one or more areas within a patch that do not meet the condition threshold criteria that are surrounded by areas of higher quality that meet the condition thresholds (Department of the Environment, 2015). Therefore, a patch may include small-scale disturbances, such as tracks or breaks, watercourses/drainage lines or small-scale (up to 0.1 ha) variations in vegetation that do not significantly alter its overall functionality (Department of the Environment, 2015). Based on this definition of a patch, there would be three discrete patches defined as:

- Patch 1 – all occurrences within Airport Reserve are considered contiguous and function as a single patch. This patch is >0.5 hectares in size
- Patch 2 – is a small <0.5 hectare area and is in the western portion of Ashford Reserve
- Patch 3 – is >0.5-hectare area and is the remaining extent of this vegetation zone within Ashford Reserve.

Based on patch size threshold (see Table 3.30), only patches 1 and 3 meet the minimum area requirement to form part of this community. Of the perennial understorey vegetation cover, native species make up greater than 70% in Patch 3 and as such this patch is in Category C – High Condition Class. Patch 1 has >30% of the perennial understorey vegetation cover made up of native species so is in the Category A – Moderate condition class (see Table 3.30).

Table 3.30 Comparison of Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community condition thresholds against candidate PCTs (Department of the Environment and Energy, 2018)

Category and rationale	Thresholds	PCT 725
A. Moderate condition class Represented by medium to large-size patch as part of a larger native vegetation remnant and/or with mature trees	Patch size is ≥ 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone) And $> 30\%$ of the perennial understorey vegetation cover is made up of native species. And The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) > 1 ha in area. Or The patch has at least one tree with hollows or at least one large locally indigenous tree (> 80 cm dbh).	Patch 1 = 1.54 ha And Patch 1 = 39.6% perennial understorey vegetation cover derived from BAM plots.
B. Moderate condition class Represented by medium to large size patch with high quality native understorey	Patch size is ≥ 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone) And $> 50\%$ of the perennial understorey vegetation cover is made up of native species.	Not applicable to patches in study area based on perennial understorey vegetation cover.
C. High condition class Represented by medium to large size patch with very high quality native understorey	Patch size is ≥ 0.5 ha And $> 70\%$ of the perennial understorey vegetation cover is made up of native species.	Patch 3 = 1.29 ha And Patch 3 varies from 72% to 87.7% perennial understorey vegetation cover derived from BAM plots.
D. High condition class Represented by large size patch with high quality native understorey	Patch size is ≥ 2 ha And $> 50\%$ of the perennial understorey vegetation cover is made up of native species.	Not applicable due to patch sizes < 2 ha.
Perennial understorey vegetation cover includes vascular plant species of the ground and mid/shrub layers with a lifecycle of more than two growing seasons. Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, plant litter or exposed soil but include plants that are subject to dieback. Contiguous means the patch of the ecological community is continuous with, or in close proximity (within 100 m), of another patch of vegetation (of the same or a different type) that is dominated by native species in each vegetation layer present.		

River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria

The River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC occurs in the study area and is associated with PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (see Figure 3.8).

To be considered part of the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC the vegetation within the study area must meet the description of the TEC provided in the *Conservation Advice for the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*

(Department of Agriculture, Water and the Environment, 2020). The vegetation must also meet the key diagnostic characteristics and condition thresholds.

Key diagnostic characteristics

An overview of key diagnostic characteristics for the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC as outlined by the Department of Agriculture, Water and the Environment (2020), against the candidate PCT from within the study area is presented in Table 3.31.

From the examination of key diagnostic characteristics, PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin within the study area meets the key diagnostic characteristics for this TEC.

Table 3.31 Comparison of River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC key diagnostics against PCT 835 from within the study area (Department of Agriculture, Water and the Environment, 2020)

Key diagnostic characteristic	PCT 835
Occurs in the South East Corner and Sydney Basin IBRA7 Bioregions, in eastern Victoria and south eastern New South Wales.	Yes Located in the Sydney Basin Bioregion.
Occurs within catchments of the eastern and southern watershed of the Great Dividing Range.	Yes Occurs within catchments of the eastern and watershed of the Great Dividing Range.
Occurs at elevations up to 250 metres above sea-level (ASL), but most typically below 50 metres ASL.	Yes Occurs at elevations below 250 metres above sea level.
Occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, including floodplains, river-banks, riparian zones, lake foreshores, creek lines (including the floors of tributary gullies), floodplain pockets, depressions, alluvial flats, fans, terraces, and localised colluvial fans.	Yes Occurs on alluvial landforms related to coastal river floodplains (Georges River).
Occurs on alluvial soils of various textures including silts, clay loams, sandy loams, gravel and cobbles. Does not occur on soils that are primarily marine sands, or aeolian sands.	Yes Occurs on alluvial soils.
Occurs as a tall closed-forest, tall open-forest, closed forest, open forest, tall woodland, or woodland. The canopy has a crown cover of at least 20 percent.	Yes Occurs as a woodland to open forest structure and has a crown cover of at least 20 percent.
Has a canopy dominated by one or a combination of the following species: <i>Angophora floribunda</i> , <i>A. subvelutina</i> , <i>Eucalyptus amplifolia</i> , <i>E. baueriana</i> , <i>E. benthamii</i> , <i>E. bosistoana</i> , <i>E. botryoides</i> , <i>E. botryoides x E. saligna</i> , <i>E. elata</i> , <i>E. grandis</i> , <i>E. longifolia</i> , <i>E. moluccana</i> , <i>E. ovata</i> , <i>E. saligna</i> , <i>E. tereticornis</i> , <i>E. viminalis</i> .	Yes The canopy is dominated by species including <i>Angophora floribunda</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus amplifolia</i> , and <i>Eucalyptus baueriana</i> .
Comparison	Meets key diagnostic characteristics

Condition thresholds

Condition thresholds are intended to function as a set of criteria that assists in identifying when the EPBC Act is likely to apply to an ecological community and provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a MNES, as defined under the EPBC Act. The condition thresholds for the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC as outlined by the Department of Agriculture, Water and the Environment (2020), are presented in Table 3.32.

A patch of the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC is defined as a discrete and mostly continuous area of the ecological community, as defined by the key diagnostic characteristics, but can include small-scale (<30 m) variations, gaps and disturbances within this area *Victoria* (Department of Agriculture, Water and the Environment, 2020). The smallest patch size that can be identified is 0.5 ha (Department of Agriculture, Water and the Environment, 2020). Based on this definition of a patch, there would be at least six discrete patches within the study area and three of the six patches are over 0.5 ha in size (see Figure 3.8)

- Patch 1 – all occurrences along the Georges River and Golf Course north of Milperra Road. This patch is >1.05 hectares in size
- Patch 2 – all occurrences on the east of Henry Lawson Drive and south of Milperra Road. This patch is >5 hectares in size
- Patch 3 – all occurrences to the west of Henry Lawson Drive and south of Milperra Road. This patch is >10 hectares in size.

Quadrats 12, 18 and 24 were done within PCT 835 in the study area. Quadrat 24 was done in a small patch that only has 1.7% perennial understorey vegetation cover, so it does not meet condition thresholds. Quadrat 12 and Quadrat 18 were done in the same patch (Patch 2) which is >5 ha in size. Quadrat 12 had a perennial native understorey vegetation cover of 30.3% while Quadrat 18 had a perennial native understorey vegetation cover of 12.2%. None of the patches within the study area are considered to be in High condition. Quadrat 12 had a perennial native understorey vegetation cover of 30.3% and ground cover richness was ≥ 4 native species (six forb and grass species, see plot data in Appendix A) which indicates that the patch is in the Moderate condition Class C2 as described by Department of Agriculture, Water and the Environment (2020). It is likely that Patch 1 and Patch 3 would also fall into this category, but we do not have plot data to confirm (note that the survey was done before the listing of this TEC under the EPBC Act, so the survey was not focused on this TEC).

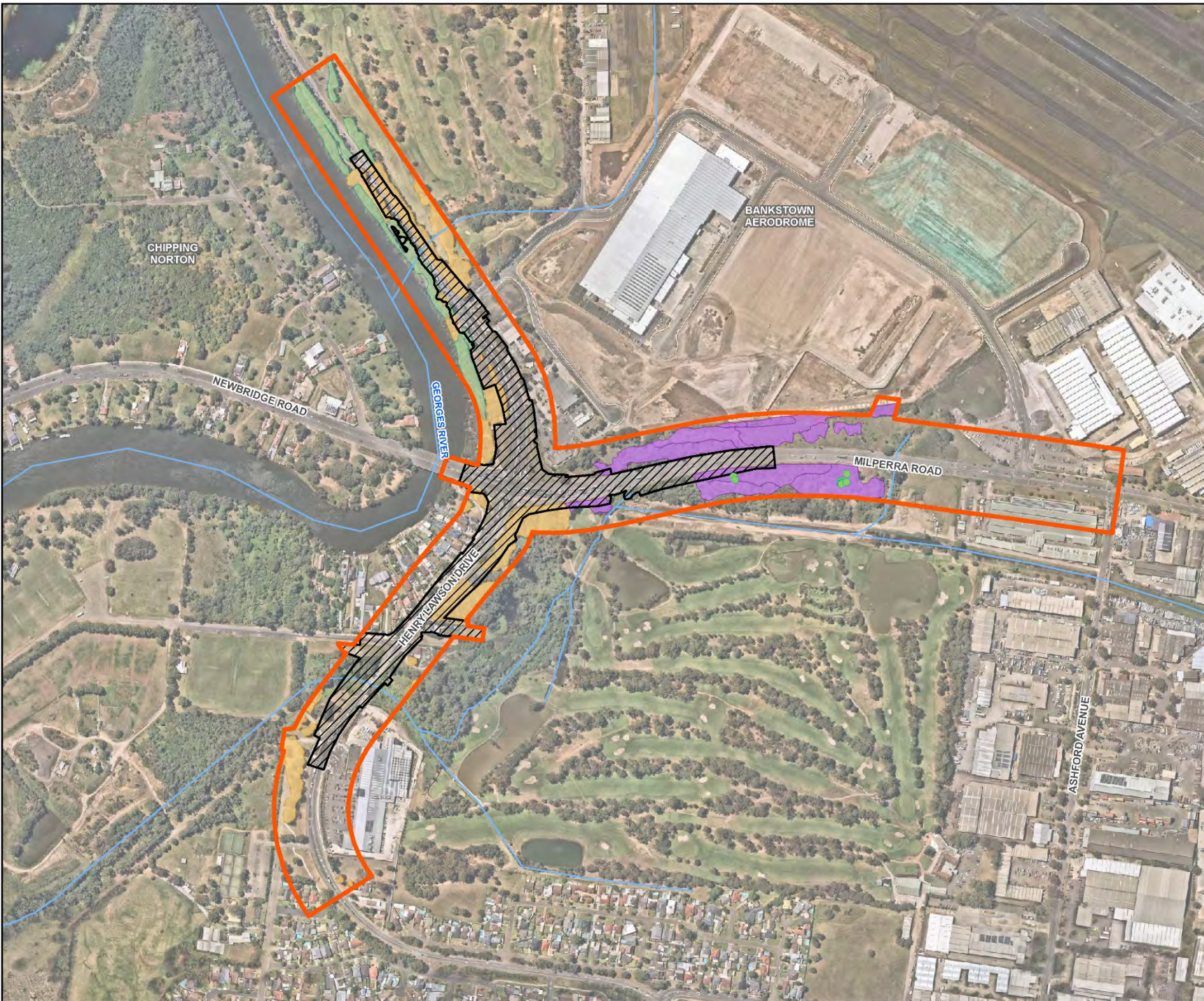
As Quadrat 12 and Quadrat 18 were done in the same patch and the data is variable we have taken a precautionary approach and have assumed the whole patch meets the condition thresholds instead of attempting to break the patch apart into separate areas as we do not have the spatial data to draw accurate lines to delineate higher and lower condition sections.

Table 3.32 Patch size and biotic thresholds for River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (Department of Agriculture, Water and the Environment, 2020)

Patch size thresholds → Biotic thresholds ↓	Large patch Patch size ≥ 2 ha	Small contiguous ⁷ patch Patch size ≥ 0.5 ha within a larger area of native vegetation ≥ 5 ha	Small patch Patch size ≥ 0.5 ha
High condition ≥ 80% of its total perennial understorey vegetation cover ¹ is comprised of native species AND Ground cover richness ² ≥ 10 native species per sample plot AND ≥ 20 large trees ³ per ha	CLASS A1 Large or contiguous patch in high condition		CLASS B1 Small patch in high condition
Good condition with arboreal mammals ≥ 50% of its total perennial understorey vegetation cover ¹ is comprised of native species AND Ground cover richness ² ≥ 8 native species per sample plot AND At least 10 large trees ³ per ha AND Evidence of 4 or more species of arboreal mammals ⁴ detected ⁵ in the patch	CLASS A2 Large or contiguous patch in good condition with arboreal mammals		CLASS B2 Small patch in good condition with arboreal mammals
Good condition ≥ 50% of its total perennial understorey vegetation cover ¹ is comprised of native species AND Ground cover richness ² ≥ 8 native species per sample plot AND At least 10 large trees ³ per ha	CLASS B3 Large or contiguous patch in good condition		CLASS C1 Small patch in good condition
Moderate condition ≥ 30% of its total perennial understorey vegetation cover ¹ is comprised of native species AND Ground cover richness ≥ 4 native species per sample plot ²	CLASS C2 Large or contiguous patch in moderate condition		
<p>¹ Perennial understorey vegetation cover includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil.</p> <p>² Ground cover richness includes combined species richness of native grasses, forbs, ferns and sedges per 0.04 ha (20 x 20 m sample plot).</p> <p>³ Large eucalypt trees are greater than 45 cm [diameter at breast height (dbh)]. This is used as a surrogate for tree hollows and habitat values.</p> <p>⁴ Excluding micro-bats (Microchiroptera).</p> <p>⁵ Survey guidelines (DSEWPC 2011).</p> <p>⁷ Contiguous means the patch is connected to, or in close proximity to (i.e. within 30 m of), another area of native vegetation (i.e. an area where the total perennial vegetation cover is dominated (50 percent or more) by native plant species).</p>			

HENRY LAWSON DRIVE STAGE 1A

Figure 3.8
Matters of National
Environmental Significance



Legend

- Study area
- REF proposal area
- EPBC listed Threatened Ecological Communities**
 - Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
 - Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
 - River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC



Coordinate system: GDA 1994 MGA Zone 56
 Scale ratio correct when printed at A3
 1:6,000 Date: 12/05/21
 Data sources - NEARmap, NSW, Geoscience Australia
 Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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3.13.3 Listed Threatened species

Threatened flora species listed under the EPBC Act

The search of the PMST identified 29 threatened flora species listed under the EPBC Act that have the potential to occur in the locality of the study area (see Appendix B). As identified above in Section 3.7.1, a population of *Acacia pubescens* (listed as Vulnerable) was recorded directly adjacent to the study area during the field survey on the southern side of Milperra Road within Ashford Reserve. The location of the recorded *Acacia pubescens* plants is shown in Figure 3.7. The targeted flora surveys did not record any other EPBC Act listed threatened flora species from within or directly adjacent to the study area.

Given that the study area is outside of the known range of many species returned from the PMST, and that the study area lacks specific habitat features (e.g. sandstone soils) for some species, many threatened plants were removed from the assessment at the early habitat assessment stage (see Appendix B). Other species were removed from the assessment as the habitats within the study area are degraded to the point that the species is unlikely to be present (see Appendix B).

Threatened fauna species listed under the EPBC Act

The search of the PMST identified 52 threatened fauna species listed under the EPBC Act that have the potential to occur in the locality of the study area (see Appendix B). This includes 30 birds (including 22 sea birds or waders that were removed from the assessment based on lack of suitable habitat in the study area), four frogs (including *Litoria raniformis* which was removed from the assessment as the species does not occur in Sydney), nine mammals, six reptiles (this includes five sea turtles that were removed from the assessment based on lack of suitable habitat in the study area), one invertebrate, and two fish.

Based on the type and quality of habitats that are present in the study area (see detailed description of the habitat types above in Section 3.2).

Given that the study area is outside of the known range of many species returned from the PMST, and that the study area lacks specific habitat features (e.g. sandstone geology, rocky outcropping, rainforest) for some species, many threatened animals were removed from the assessment at the early habitat assessment stage (see Appendix B). Other species were removed from the assessment as the habitats within the study area are degraded to the point that the species is unlikely to be present (see Appendix B). The three EPBC Act listed threatened fauna species that are considered at least moderately likely to occur within the study area on occasion include:

- Swift Parrot (listed as Critically Endangered)
- White-throated Needletail (listed as Vulnerable)
- Grey-headed Flying-fox (listed as Vulnerable).

The Swift Parrot and Grey-headed Flying-fox are considered moderately likely to be present based on the presence of suitable foraging habitats. These species are known from the locality and it is assumed that the native vegetation within the study area provides suitable foraging habitat. There is no breeding habitat for these species within or adjacent to the study area.

As discussed below in Section 3.13.4, the White-throated Needletail spends the non-breeding season in Australia and is primarily aerial. As such, this species may fly over the study area as part of normal movement patterns and this species not considered relevant to this assessment as no habitat for this species will be impacted directly or indirectly.

3.13.4 Listed Migratory Species

Migratory species are protected under international agreements, to which Australia is a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered Matters of NES and are protected under the EPBC Act.

The search of the PMST identified 43 listed Migratory species listed under the EPBC Act that have the potential to occur in the locality of the study area. This includes a number of Migratory Marine Birds (e.g. Albatrosses, Petrels, Shearwaters, Noddy, Frigatebird, etc.) that would not use the habitats in the study area. The list of Migratory species returned by the PMST also includes a number of Migratory Marine Species including sea turtles and sharks and rays that do not have habitat in the study area. Likewise, the PMST returned a number of Migratory Wetlands Species (wading birds) that do not have any suitable habitat within the study area.

Table 3.33 outlines the two listed Migratory species that have the potential to occur in the study area.

Table 3.33 Migratory species with a moderate or higher likelihood of occurrence in the study area

Scientific Name	Common Name	EPBC Act	Likelihood of occurrence
<i>Hirundapus caudacutus</i>	White-throated Needletail	M; Ma	Moderate - The White-throated Needletail spends the non-breeding season in Australia and is primarily aerial. As such, this species may fly over the development site as part of normal movement patterns and are not considered relevant to this assessment as no habitat for these species will be impacted directly or indirectly.
<i>Pandion cristatus</i>	Eastern Osprey	M; Ma	Moderate - The species is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. There is potential for the species to forage along the Georges River.

Listed under the EPBC Act

It should also be noted that habitats in the study area are unlikely to constitute important habitat for any of the listed migratory species (see Appendix B). The habitat present in the study area was unlikely to support significant proportions of populations of any migratory species nor are the habitats in the study area critical to any life stage of identified species. Due to their mobile nature, these species are likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur. Because of this, these species are not considered to be significantly impacted by the REF proposal and are not considered further in this report.

4 Impact assessment

The REF proposal's likely direct and indirect impacts on biodiversity during construction and operational phases are summarised in this chapter. There are a range of potential biodiversity impacts that may occur due to the REF proposal including:

- removal of native vegetation
- removal of threatened fauna species habitat and habitat features
- removal of threatened plants
- aquatic impacts
- injury and mortality
- alteration to wildlife connectivity and habitat fragmentation
- edge effects on adjacent native vegetation and habitat
- invasion and spread of weeds
- invasion and spread of pests
- invasion and spread of pathogens and disease
- changes to hydrology
- noise, light and vibration
- impacts to groundwater dependent ecosystems.

Figure 4.1 illustrates the overview of impacts to biodiversity values.

4.1 Construction impacts

4.1.1 Removal of native vegetation

Under the current concept design, the estimated clearing of native vegetation is about 3.16 hectares for the REF proposal consisting of the following PCTs:

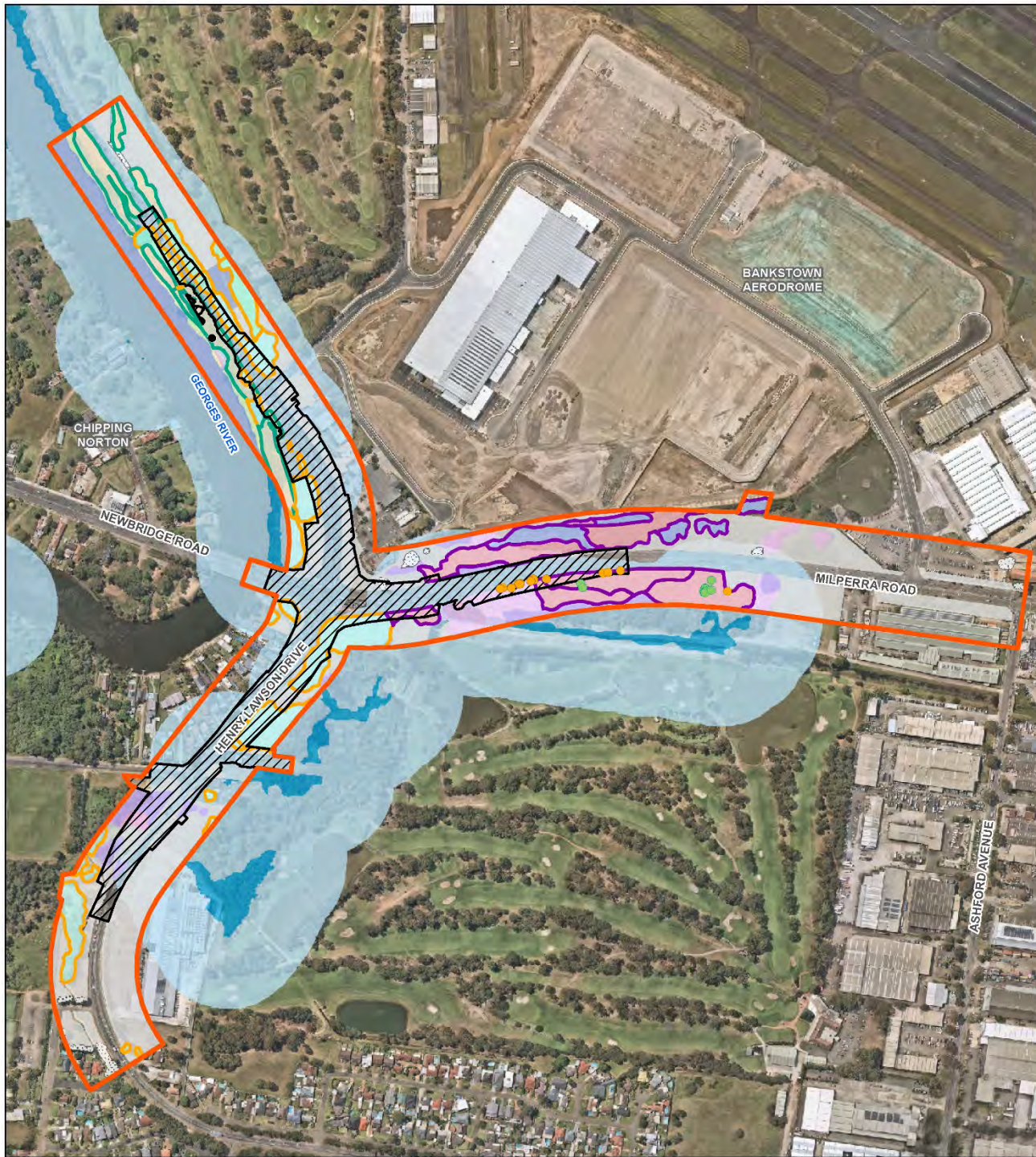
- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – moderate condition
- PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 1236 - Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

A breakdown of approximate native vegetation removal in each vegetation zone is provided in Table 4.1. The impacts assessed here are based on the concept design construction footprint.

The local occurrence of each PCT is defined as the area of the PCT that occurs within the study area and adjacent areas that form part of a larger contiguous area of the PCT, in which movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.

The REF proposal would also result in the removal of about 0.3 ha of miscellaneous ecosystem – exotic / landscape plantings and about 8.93 ha of miscellaneous ecosystem – weeds / exotics – non-native vegetation with no or limited native vegetation.

Figure 4.1
Impacts on Biodiversity Values



EPBC listed Threatened Ecological Communities

- █ Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- █ Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- █ River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered - BC Act)

VZ1a: PCT725 - Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Poor condition (regrowth)

VZ1: PCT725 - Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition

Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered - BC Act)

VZ2: PCT781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition

River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act)

VZ4: PCT835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)

VZ3: PCT835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered - BC Act)

VZ11: PCT1236 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition

VZ13: PCT1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition

VZ12: PCT1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition

Other vegetation communities not listed as Threatened Ecological Communities

VZ5: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin – Moderate condition

VZ9: PCT920 - Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Moderate condition

VZ7: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin – Poor condition (canopy only)

VZ6: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin – Moderate condition (regrowth)

VZ8: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin – Poor condition (regenerating native understorey – planted canopy)

Miscellaneous ecosystems

VZ15: Miscellaneous ecosystem - Weeds / exotics – non-native vegetation

VZ14: Miscellaneous ecosystem - Urban exotic / native landscape plantings

VZ16: Miscellaneous ecosystem - Waterbodies

Legend

 Study area

 REF proposal area

Threatened species

● *Acacia pubescens*

● *Callistemon linearifolius*

● Microbat roosting culvert (Southern Myotis)

Coastal wetlands

Coastal wetland (only wetlands within vicinity of footprint shown)

100m buffer zone



Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:6,000 Date: 15-Jul-21

Data sources - NEARMAP, NSW, Geoscience Australia, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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Table 4.1 Impacts on native vegetation

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region ¹	Area (ha) REF proposal area ²
PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Moderate condition	E	CE	95%	0.21
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Moderate condition	E	-	74%	0.07
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Moderate condition – Forest Red Gum variant	E	CE	93%	0.77
	Moderate condition – Blue Box variant				0.19
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Poor condition	E	-	32%	0.14
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Moderate condition	E	E	90%	0.10
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Poor condition	E	E	60%	0.21
Total extent of native vegetation impact					1.69

(1) Based on the VIS classification database.

(2) Area to be cleared based on ground-truthed vegetation mapping within the study area.

4.1.2 Removal of threatened fauna habitat

The extent of vegetation clearing estimated to result from the REF proposal is outlined above in Section 4.1.1. This vegetation, including planted trees, provides suitable habitat for a range of threatened fauna species listed under the BC Act and EPBC Act. As such, direct impacts to habitat for threatened fauna species (although it is only moderate to poor quality) would occur during construction.

The direct impacts of the REF proposal to habitats for threatened fauna has been estimated based on the current concept design. A breakdown of the direct impacts to habitat for threatened fauna species is provided in Table 4.2.

Table 4.2 Impacts on threatened fauna and fauna habitat

Species	Potential occurrence	Habitat impacted by REF proposal	Impact (ha/individuals)
<i>Artamus cyanopterus cyanopterus</i> (Dusky Woodswallow)	Moderate	PCT 725, PCT835	1.17
<i>Pandion cristatus</i> (Eastern Osprey)	Moderate	PCT835, PCT1234, PCT1800	1.27
<i>Glossopsitta pusilla</i> (Little Lorikeet)	Moderate	PCT 725, PCT835	1.17
<i>Lathamus discolor</i> (Swift Parrot)	Moderate	PCT 725, PCT835	1.17

Species	Potential occurrence	Habitat impacted by REF proposal	Impact (ha/ individuals)
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	Moderate	PCT 725, PCT835	1.17
<i>Haliaeetus leucogaster</i> (White-bellied Sea-eagle)	Moderate	PCT835, PCT1234, PCT1800	1.27
<i>Hirundapus caudacutus</i> (White – throated Needletail)	Moderate	PCT 725, PCT835	1.17
<i>Miniopterus australis</i> (Little Bent-winged Bat)	Moderate	All PCTs	1.69
<i>Miniopterus orianae oceanensis</i> (Large Bent - winged Bat)	Moderate	All PCTs	1.69
<i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle)	Moderate	All PCTs	1.69
<i>Mormopterus norfolkensis</i> (Eastern Coastal Free – tailed Bat)	Moderate	All PCTs	1.69
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	Moderate	All PCTs	1.69
<i>Myotis macropus</i> (Southern Myotis)	Recorded	PCT835, PCT1234, PCT1800	1.27
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheathtail Bat)	Moderate	PCT 725, PCT835	1.17
<i>Pteropus poliocephalus</i> (Grey-headed Flying Fox)	Moderate	PCT 725, PCT835	1.17

4.1.3 Removal of threatened plants

There will be direct impacts to one threatened flora species, *Callistemon linearifolius* (Netted Bottle Brush) recorded within the study area.

Twenty-nine individuals of the threatened flora species, *Callistemon linearifolius* (Netted Bottle Brush), which is listed as Vulnerable under the BC Act and the EPBC Act, were recorded in the study area. All individuals of this species were recorded along the southern verge of Milperra Road and within Ashford Reserve. Of the twenty-nine plants, the only plants to be impacted are the twenty-three growing on the existing roadside verge. Six plants growing in remnant bushland in Ashford Reserve will be retained and protected.

The direct impacts of the REF proposal to threatened plant species has been estimated based on the current design. A breakdown of the direct impacts to threatened flora species and their habitats is provided in Table 4.3.

Table 4.3 Impacts on threatened flora

Species	Potential occurrence	Habitat impacted by REF proposal	Impact (ha/ individuals)
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	Recorded	Yes – removal	23 individuals

4.1.4 Aquatic impacts

Unmitigated impacts to aquatic habitats (specifically Georges River) may arise from construction activities. The potential impacts on aquatic ecology are mainly due to the orientation of Henry Lawson Drive which runs parallel or adjacent to the Georges River for most of the study area. Relatively high aquatic biodiversity values are associated with the riparian vegetation present along most of the study area which is dominated by fringing river mangroves which are interspersed with and backed by Swamp Oak forest and eucalypt forest vegetation communities. While riparian vegetation within the study area contains weeds and

exotic species the mangrove habitat present represents a significant natural aquatic feature of high conservation value.

Local indirect effects of removal of riparian vegetation potentially include degraded water quality due to increased sediment-laden runoff, long term bank erosion, mobilisation of potential acid sulphate soils, decrease in food availability for aquatic biota and water birds and loss of bank-associated aquatic habitat such as overhangs and shade.

Direct impacts on listed threatened fish species are unlikely due to the low probability of their occurrence in the study area.

Two KTPs associated with removal of riparian vegetation would be contributed to by the REF proposal and these have potential to impact aquatic ecology:

- Clearing of native vegetation, and
- The degradation of native riparian vegetation along New South Wales water courses.

Both KTPs address the potential consequences on aquatic ecology of removal of vegetation immediately along river and creek banks (such as mangroves) and behind them (such as Swamp Oak forest and eucalypt forest) which provide important ecosystem functions. Removal of riparian vegetation could degrade water quality due to increased sediment-laden runoff, intensify longer term bank erosion, mobilise potential acid sulphate soils, decrease food availability for aquatic biota and result in loss of bank-associated habitat such as overhangs and shade.

Impacts to aquatic habitat require mitigation measures would be implemented to limit impacts.

Impact to Key Fish Habitat

The Georges River is the only mapped Key Fish Habitat within the study area. However, the mapped Key Fish Habitat of the Georges River is outside of the REF proposal area so no direct impacts to mapped Key Fish Habitat will occur.

Impact to proximity area for coastal wetlands

The study area occurs within and immediately adjacent to areas mapped as 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' as determined by the Coastal Management SEPP (illustrated in Figure 3.7).

The REF proposal area will not directly impact the mapped Coastal Wetlands but it will impact on about 7.10 hectares of Proximity Coastal Wetlands (100 metre buffer). The REF proposal incorporates the majority of the overall proposal, however, excludes works which are located within the SEPP (Coastal Management) area.

Indirect impact – Voyager Point Nationally Important Wetland

There is potential for a negative indirect impact on the Voyager Point wetland, due to an increase in suspended sediments in estuarine water that generally accompany vegetation removal and promote subsequent bank erosion. Prolonged elevated turbidity could reduce water quality and plant growth which in turn would reduce foraging and roosting habitat for listed threatened and migratory bird species.

As the best practice design for the road upgrade would likely avoid the removal of mangroves and would control sediment runoff into the Georges River, significant impacts on these wetland habitats would be unlikely. It is unlikely that EPBC Act referrals would be required.

4.1.5 Injury and mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microbat species), may find it difficult to rapidly move away from the clearing when disturbed. The study area is only likely to contain a limited number of arboreal species (e.g. possums) and birds that may be impacted during vegetation removal. Reptiles and frogs may also be impacted during construction as habitat is cleared.

Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

There is a chance of fauna mortality during the operational phase of the REF proposal through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike. As there are no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations is unknown. With the expansion of an existing road the risk of vehicle strike should remain in a similar level to that currently experienced but the significance of such an impact cannot be predicted. The impact on threatened species however is expected to be minimal. Based on evidence from other roadways in the locality most vehicle strike impacts can be expected to occur to common mammals such as birds and possums and exotic animals including foxes.

Mitigation measures designed to reduce an injury and mortality of fauna are provided in Section 5.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity and habitat fragmentation

Habitat fragmentation *per se* relates to the physical dividing up of once continuous habitats into separate smaller 'fragments'. The habitats within the study area are fragments that have formed since the initial habitat clearing that has occurred. The current alignment of Henry Lawson Drive and Milperra Road divide the remaining habitats in the study area. The barrier posed by the existing Henry Lawson Drive and Milperra Road serve to restrict fauna movements between habitat patches. However, functional habitat connectivity for more mobile species (e.g. birds, flying-foxes, microbats, insects, plants) is still present. The current roadways do not totally prevent fauna movement between habitat fragments (fauna can and likely do cross the road) but the roads do create a considerable hazard.

The REF proposal would not break apart continuous habitats into separate smaller fragments. The REF proposal would however result in an increase in isolation of habitats as the current habitat patches would be made smaller which would increase the physical distance between habitat fragments. The isolation that may be caused by the REF proposal is not likely to have an appreciable impact on nomadic or migratory species such as birds. The REF proposal is likely to be detrimental to the dispersal of arboreal mammals and other species including frogs and reptiles, but the effects would only be marginally greater than that which is already experienced.

The predicted level of isolation from the REF proposal is not likely to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. Functional connectivity for many species would remain in the study area. However, local division of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability for some species may result.

This impact would be of low magnitude and specific mitigation measures are not deemed to be necessary.

4.2.2 Edge effects on adjacent native vegetation and habitat

Edge effects create vulnerable areas subject to degradation by the establishment and spread of weeds, enriched run-off from road pavement and dumping of rubbish and have the potential to reduce the viability of adjacent habitat long-term. It is listed as a Key Threatening Processes under BC Act.

Currently, edge effects from the Henry Lawson Drive and Milperra Road impact native vegetation particularly through weed invasion. As the REF proposal involves widening the

road this impact is likely to exacerbate and introduce this impact into additional areas of native vegetation and habitat.

The vegetation recorded within the study area mostly occurred in linear patches with some degree of weed invasion. Vegetation recorded in moderate condition and/or with connectivity to larger patches of vegetation is most vulnerable to edge effects. The viability of these areas may be reduced by the REF proposal if not appropriately managed.

Post construction landscapes should be restricted to native local indigenous plants and as such this impact would be of low magnitude and additional mitigation measures are not deemed necessary.

4.2.3 Invasion and spread of weeds

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of REF proposal activities). Proliferation of weeds is likely to occur during construction and operation, although impacts would be greatest because of vegetation clearing during the construction phase. The most likely causes of weed dispersal and importation associated with the REF proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. The study area contains significant weed growth and no undisturbed weed free habitat exists. As such, weeds must be managed during construction.

This indirect impact corresponds to several Key Threatening Processes listed under BC Act:

- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara* (Lantana)
- Invasion of native plant communities by *Olea europaea subsp. cuspidate* (African Olive)
- Invasion of native plant communities by *Chrysanthemoides monilifera* (Bitou Bush)
- Invasion of native plant communities by exotic perennial grasses
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

Mitigation measures designed to limit the spread and germination of weeds are provided in Section 5.

4.2.4 Invasion and spread of pests

The study area is currently habitat for a range of commonly occurring pest species including European Fox, Black Rat and possibly rabbits. REF proposal activities have the potential to disperse pest species out of the REF proposal area across the surrounding landscape, but the magnitude of this impact would be low and mitigation measures are not deemed necessary.

4.2.5 Invasion and spread of pathogens and disease

Plant and animal pathogens can affect threatened biodiversity through direct mortality and modification to vegetation structure and composition. The following pathogens are considered to have potential to affect the biodiversity within the REF proposal area and are the subject of Key Threatening Process listings:

- Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)
- Exotic Rust Fungi (order Pucciniales, e.g. Myrtle rust fungus *Uredo rangelii*)
- Phytophthora Root Rot Fungus (*Phytophthora cinnamomi*).

These three pathogens have all been recorded in the Sydney Basin bioregion and have potential to occur on within the REF proposal site at present or in the future.

The main way in which Exotic Rust Fungi and Phytophthora Root Rot Fungus may be spread is through the movement of infected plant material and/or soil. The construction and operation of the REF proposal may increase the risk of disturbing and spreading these pathogens. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the REF proposal area, the risk of introducing these pathogens would, however, be low. Preferential use of plant materials sourced on-site (e.g. mulch, seeds) used for vegetation restoration would also help to minimise this risk.

Amphibian Chytrid Fungus can be spread through the movement of infected animals or water (including mud or moist soil) from infected areas. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the REF proposal area, the risk of introducing this pathogen to uninfected areas is low.

Pathogens would be managed within the REF proposal site according to the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011) (see Section 5).

4.2.6 Changes to hydrology

The existing hydrological conditions of the REF proposal are already affected by altered landform and altered stormwater runoff and velocity because of surrounding land uses and existing roads. The REF proposal may result in further alteration to the hydrology of the study area due to an increase in surface runoff.

The stormwater design for operational phase would aim to maintain, wherever possible, the existing flood regime and levels as identified by Lyall & Associates (2018). Upgrading of transverse drainage along Henry Lawson Drive, upgrade of existing stormwater drainage system and raising of Henry Lawson Drive in strategic locations is recommended (Lyall & Associates, 2018). It is recommended that the stormwater design for the overall Proposal be done in accordance with 'Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction, Sydney' (Blue Book) (Department of Environment & Climate Change, 2008) to avoid potential impacts to surrounding native vegetation communities.

4.2.7 Noise, light and vibration

Considering the existing levels of noise and vibration from the surrounding urban development and the high levels of use of the existing Henry Lawson Drive and Milperra Road by vehicles, it is unlikely there would be a significant increase in noise and vibration during operation of the road that would result in any increased impacts to biodiversity within the study area. There is however potential for impacts to locally common fauna from noise and vibration during construction, which may result in fauna temporarily avoiding habitats adjacent to the construction, however traffic noise is likely to be significant deterrent to most fauna groups already. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

Lighting maybe used at night to enable work to be completed that may result in impacts to nocturnal fauna. Nocturnal species such as possums and microbats may avoid the habitat in the study area during construction as temporary 'daylight' conditions would be created by the mobile lighting system. This impact is considered temporary and would not have long lasting effects on the biodiversity of the study area. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

4.2.8 Groundwater dependent ecosystems

The possible effect of changes to groundwater flows on GDEs is assessed in this section.

GDEs include a diverse range of ecosystems from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water (Hatton and Evans, 1998)).

GDEs which are surface expressions of groundwater within the locality of the study area (<10 km) include the Georges River. Other GDEs which are reliant on subsurface groundwater in the study area include:

- PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 920 - Mangrove Forest in Estuaries of the Sydney Basin and South East Corner

- PCT 1236 - Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

The groundwater impact assessment provided by Aurecon (2021) indicated the following: There are no planned works as part of construction of the REF proposal that would result in flow obstruction or interference beyond localised piling at the Auld Avenue bridge. Localised piling only affects a small spatial extent and flow interference would be on the scale of 10-1m. As such, potential for aquifer interference is considered to be low.

Based on current design information pavement, utility and drainage excavations for the REF proposal are likely to be shallow (<1.5m – 2m) compared to groundwater levels generally being 2.8–5 mbgl. Therefore, no groundwater extraction or lowering of the water table by dewatering is expected.

Bridge piles (Auld Avenue bridge) may reach depths of approximately 30 mbgl but are subject to further analysis during detail design. Groundwater ingress into the bored piles is likely to occur although construction methodologies may be adopted to minimise groundwater ingress. As such, it is considered unlikely that any significant groundwater dewatering will be required as part of construction and thus the potential for aquifer interference is very low.

There is potential for impacts to aquatic and terrestrial GDEs through leaching of potential acid sulfate soils into GDE habitats during construction, stormwater discharges leading to burial by sediment and toxicological impacts from potential contaminants, and through transport of existing contaminant sources through preferential drainage paths (i.e. backfilled utilities trenches) during construction and operational phases.

Due to the relatively minor extent of excavations and the implementation of environmental groundwater safeguards it is unlikely that interception of groundwater flows would significantly affect groundwater dependent ecosystems within the study area. The REF proposal is not expected to substantially interfere with subsurface or groundwater flows associated with the Georges River.

4.3 Cumulative impacts

The incremental effect of multiple sources of impact (past, present and future) are referred to as cumulative impacts (Contant and Wiggins, 1991, Council on Environmental Quality, 1978). Cumulative impact assessment considers a proposal within the context of other past, present and likely future sources of impact. This is necessary to identify any impacts associated with the proposal that may have an additive effect or interaction with impacts from other activities within the locality to the extent that the overall (cumulative) impact becomes significant when it would not otherwise have been significant.

The potential cumulative biodiversity impacts as a consequence of the construction and operation of the REF proposal are discussed here within the context of the existing environment, present and likely future impacts.

Residential and infrastructure development in the locality in historic and recent times has led to extensive vegetation clearing in the locality and at the catchment scale. Remaining remnant vegetation/habitat has also been affected by a variety of disturbance mechanisms, including clearing of undergrowth, altered fire regimes, feral animals and weed invasion. This habitat loss and disturbance has resulted in the local extinction of a number of species which are less tolerant of habitat loss and disturbance (e.g. woodland birds and small mammals) and an increased risk of extinction to a number of vegetation communities.

Isolated remnant populations of disturbance-sensitive threatened species in such a landscape may be susceptible to local extinction due to seemingly small reductions in habitat area or quality, if the habitat is near the lower limit in size or quality necessary to support a viable population and a critical threshold is reached.

In assessing the cumulative impact of a REF proposal, it is important to consider whether the additive effects of multiple projects may cause such a critical threshold to be reached for any threatened biodiversity affected. Importantly, critical thresholds for many PCTs in the subregion have already been reached. For example, PCT 1234 has been 90% cleared, PCT 781 has been 75% cleared, PCT 835 has been 93% cleared, and PCT 725 has been 95% cleared.

A number of developments are underway or planned in the locality, that also impact on biodiversity values that are likely to be impacted by the current REF proposal. These are summarised in Table 4.4. The impacts from the Bankstown Airport Redevelopment South West Precinct and the Glenfield Waste Services Materials Recycling Facility have contributed significantly to the cumulative impact totals. Comparitively, the contribution of the proposal to cumulative impacts is very low. The impacts of the proposal are considered unlikely to add signifantly to the cumulative impacts of past, concurrent and future projects given the relatively small impact at 1.69 ha of roadside vegetation.

Table 4.4 Past, present and future projects within the vicinity of the REF proposal

Project	Project stage	Biodiversity value impacted
Bankstown Airport Redevelopment South West Precinct	Construction phase	<ul style="list-style-type: none"> Biodiversity – clearing of 3.5 ha of native vegetation Habitat for Grey-headed Flying Fox, Green and Golden Bell Frog, seven Microchiropteran Bats, Swamp Harrier, Little Eagle, Square-tailed Kite, Eastern Osprey, Varied Sittella, Dusky Woodswallow, Scarlet Robin and Flame Robin
SIMTA Intermodal Facility	Construction Phase	<ul style="list-style-type: none"> Biodiversity – clearing of 1.23 hectares of native vegetation
Glenfield Waste Services Materials Recycling Facility	Planning and Assessment phase	<ul style="list-style-type: none"> 9.5 hectares of critically endangered Cumberland Plain Shale Woodland and Shale Gravel Transition Forest 5 threatened bat species recorded
Riverlands subdivision - Milperra	Planning and assessment phase	<ul style="list-style-type: none"> 0.54 ha River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions 0.48 ha Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions Southern Myotis Green and Golden Bell Frog
Milperra Drain Widening	Construction Phase	<ul style="list-style-type: none"> 0.83 ha of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions 0.15 ha of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
Henry Lawson Drive – Intersection Upgrades, Georges Hall	Planning and assessment phase	<ul style="list-style-type: none"> 0.47 ha of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions 0.02 ha of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions Habitat for Grey-headed Flying-fox, White-bellied Sea-eagle, Dusky Woodswallow and Little Lorikeet

Project	Project stage	Biodiversity value impacted
Henry Lawson Drive – EIS proposal for Stage 1A	Planning and assessment phase	<ul style="list-style-type: none"> 0.02 ha of Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions 0.02 ha of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions 0.21 ha of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
Henry Lawson Drive – REF proposal for Stage 1A	This proposal	<ul style="list-style-type: none"> 1.69 ha as detailed in Section 4.1.1.
Cumulative totals		<ul style="list-style-type: none"> 18.66 ha of vegetation and habitat removal

4.3.1 Cumulative impacts to Freshwater Wetlands on Coastal Floodplains

Both the EIS proposal and the REF proposal will have direct impacts on the Freshwater Wetlands on Coastal Floodplains threatened ecological community listed as Vulnerable under the BC Act. The combined impacts of the overall proposal would be the direct removal of 0.09 ha of PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner to coastal wetlands as summarised in Table 4.5.

Table 4.5 Cumulative Impact to Freshwater Wetlands

Proposal area	Area of Freshwater Wetland impacted (ha)
REF proposal area	0.07
EIS proposal area	0.02
Total Impact	0.09

Within the EIS proposal area, impacts to PCT 781 would be restricted to EIS proposal area 2. PCT 781 would also be directly impacted at two locations within the REF proposal footprint area being; on the southern side of Milperra Road and to the south of Auld Avenue on the eastern side of Henry Lawson Drive.

4.3.2 Cumulative impacts to areas of Coastal Wetlands and Proximity Coastal Wetlands (100 metre buffer)

About 7.10 ha of proximity area for coastal wetlands would be directly impacted by the REF proposal, which would include removal of threatened biodiversity (see Section 3.11.1).

The EIS proposal only contains about 0.26 of Coastal Wetlands and 0.02 ha of the proximity area and would only have direct impacts to these small areas but has potential to contribute to indirect impacts. Due to the nature and scale of activities of the EIS proposal, the indirect impacts as outlined in the BDAR and the EIS would be comparatively minor compared to the more direct impacts caused by the REF proposal to the proximity area. The REF proposal is contributing the most to the impact to proximity areas for coastal wetlands.

4.4 Assessments of significance

Assessment of Significance have been conducted for threatened species and ecological communities that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat.

The proposed works would be assessed under Part 5, Division 5.1 of the EP&A Act. 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 threatened species or ecological communities listed under the BC Act. Assessments were undertaken in accordance with the guidelines provided

in the *Threatened Species Test of Significance Guidelines: The Assessment of Significance* (Office of Environment & Heritage, 2018) which outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the former 'seven-part test'. The guidance provided by the Department of Environment and Climate Change (2007) has been used here in preparing these tests of significance and in determining whether there is likely to be a significant effect to a threatened species, population or ecological community listed under the BC Act.

Full details of assessment of significance under the BC Act are presented in Appendix C. The conclusions of the EP&A Act assessment are provided in Table 4.6, which indicates that a significant effect is considered unlikely on any threatened species or ecological communities listed under the BC Act.

Table 4.6 Summary findings of the BC Act test of significance

Threatened species, or communities	Significance assessment question ¹					Likely significant effect?
	a	b	c	d	e	
Cooks River/Castlereagh Ironbark Forest in the Sydney Bioregion	X	N	N	N	Y	Unlikely
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion	X	N	N	N	Y	Unlikely
River – Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	X	N	N	N	Y	Unlikely
Swamp – oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	X	N	N	N	Y	Unlikely
<i>Acacia pubescens</i> (Downy Wattle)	N	X	N	N	Y	Unlikely
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	N	X	N	N	Y	Unlikely
<i>Artamus cyanopterus cyanopterus</i> (Dusky Woodswallow)	N	X	N	N	Y	Unlikely
<i>Pandion cristatus</i> (Eastern Osprey)	N	X	N	N	Y	Unlikely
<i>Glossopsitta pusilla</i> (Little Lorikeet)	N	X	N	N	Y	Unlikely
<i>Lathamus discolor</i> (Swift Parrot)	N	X	N	N	Y	Unlikely
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	N	X	N	N	Y	Unlikely
<i>Haliaeetus leucogaster</i> (White-bellied Sea-eagle)	N	X	N	N	Y	Unlikely
<i>Hirundapus caudacutus</i> (White – throated Needletail)	N	X	N	N	Y	Unlikely
<i>Miniopterus australis</i> (Little Bent-winged Bat)	N	X	N	N	Y	Unlikely
<i>Miniopterus orianae oceanensis</i> (Large Bent - winged Bat)	N	X	N	N	Y	Unlikely
<i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle)	N	X	N	N	Y	Unlikely
<i>Mormopterus norfolkensis</i> (Easstern Coastal Free – tailed Bat)	N	X	N	N	Y	Unlikely
<i>Cercartetus nanus</i> (Eastern Pygmy possum)	N	X	N	N	Y	Unlikely
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	N	X	N	N	Y	Unlikely
<i>Myotis macropus</i> (Southern Myotis)	N	X	N	N	Y	Unlikely
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheathtail Bat)	N	X	N	N	Y	Unlikely
<i>Pteropus poliocephalus</i> (Grey Headed Flying Fox)	N	X	N	N	Y	Unlikely

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable.

(1) Significance Assessment Questions as set out in the *Biodiversity Conservation Act 2016*:

- 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.
- 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,
- 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.
- 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),
- 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

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.

A significant impact is considered unlikely for any Matter of NES and a referral of the REF proposal would not be required (see Table 4.7). Full details of the assessment of significance for threatened species under the EPBC Act are presented in Appendix C.

Table 4.7 Summary findings of the EPBC Act significance assessments

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population+	Likely Significant Impact	
	1	2	3	4	5	6	7	8	9			
Vulnerable species*												
<i>Acacia pubescens</i> (Downy Wattle)	N	N	N	N	N	N	N	N	N	N	N	Unlikely
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	X	X	X	N	X	N	N	N	N	N	N	Unlikely
Critically Endangered species												
<i>Lathamus discolor</i> (Swift Parrot)	N	Y	N	N	N	N	N	N	N	Y	N	Unlikely
<i>Hirundapus caudacutus</i> (White – throated Needle-tail)	N	N	N	N	N	N	N	N	N	N	N	Unlikely

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- (1) reduce the extent of an ecological community
- (2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- (3) adversely affect habitat critical to the survival of an ecological community
- (4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
- (5) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
- (6) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
 - assisting invasive species, that are harmful to the listed ecological community, to become established, or
 - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or

(7) interfere with the recovery of an ecological community.

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

- (1) Lead to a long-term decrease in the size of a population
- (2) Reduce the area of occupancy of the species
- (3) Fragment an existing population into two or more populations
- (4) Adversely affect habitat critical to the survival of a species
- (5) Disrupt the breeding cycle of a population
- (6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- (7) Result in invasive species that are harmful to a species becoming established in the species' habitat
- (8) Introduce disease that may cause the species to decline
- (9) Interfere with the recovery of the species.

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
- (2) reduce the area of occupancy of an important population
- (3) fragment an existing important population into two or more populations
- (4) adversely affect habitat critical to the survival of a species
- (5) disrupt the breeding cycle of an important population
- (6) modify, destroy, remove or 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
- (8) introduce disease that may cause the species to decline, or
- (9) interfere substantially with the recovery of the species.

An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range. The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered an important population for the purposes of this assessment.

4.5 Impact summary

A summary of potential impacts that have been addressed in this report are presented in Table 4.8.

Table 4.8 Summary of impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the REF proposal constitute or exacerbate a Key Threatening Process?	Confidence in assessment
Removal of native vegetation	Native vegetation	Direct	1.69 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known
	Cooks River/Castlereagh Ironbark Forest	Direct	0.21 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known
	Freshwater Wetlands on Coastal Floodplains	Direct	0.07 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known
	River Flat Eucalypt Forest of Coastal Floodplains	Direct	0.96 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known
	Swamp Oak Floodplain Forest	Direct	0.45 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known
Removal of threatened fauna habitat	Applicable to the follow threatened species: <i>Artamus cyanopterus cyanopterus</i> (Dusky Woodswallow), <i>Pandion cristatus</i> (Eastern Osprey), <i>Glossopsitta pusilla</i> (Little Lorikeet), <i>Lathamus discolor</i> (Swift Parrot), <i>Daphoenositta chrysoptera</i> (Varied Sittella), <i>Haliaeetus leucogaster</i> (White-bellied Sea-eagle), <i>Hirundapus caudacutus</i> (White-throated Needletail), <i>Miniopterus australis</i> (Little Bent-winged Bat), <i>Miniopterus orianae oceanensis</i> (Large Bent-winged Bat), <i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle), <i>Mormopterus norfolkensis</i> (Eastern Coastal Free-tailed Bat), <i>Cercartetus nanus</i> (Eastern Pygmy-possum), <i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat), <i>Myotis macropus</i> (Southern Myotis), <i>Saccolaimus flaviventris</i> (Yellow-bellied Sheathtail Bat), <i>Pteropus poliocephalus</i> (Grey-headed Flying Fox)	Direct	1.69 ha	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the REF proposal constitute or exacerbate a Key Threatening Process?	Confidence in assessment
Removal of threatened flora	<i>Callistemon linearifolius</i> (Netted Bottle Brush)	Direct	23 individuals	Long term	<ul style="list-style-type: none"> Clearing of native vegetation 	Known
Aquatic impacts	Applicable to all 1 st order ephemeral stream	Direct / indirect	Site based	Short term	<ul style="list-style-type: none"> Instream structures and other mechanisms that alter natural flow 	Known
Injury and mortality of fauna	Applicable to less mobile or sedentary fauna	Direct	Site based	Short term	N/A	Known
Wildlife connectivity and habitat fragmentation	Applicable to less mobile or sedentary fauna	Direct / indirect	Local	Long term	<ul style="list-style-type: none"> Clearing of native vegetation 	Known
Edge effects on adjacent native vegetation and habitat	Cooks River/Castlereagh Ironbark Forest, Freshwater Wetlands on Coastal Floodplains, River Flat Eucalypt Forest of Coastal Floodplains, Swamp Oak Floodplain Forest	Indirect	Local	Long term	<ul style="list-style-type: none"> Invasion and establishment of exotic vines and scramblers Invasion, establishment and spread of <i>Lantana camara</i> (Lantana) Invasion of native plant communities by <i>Olea europaea subsp. cuspidate</i> (African Olive) Invasion of native plant communities by <i>Chrysanthemoides monillifera</i> (Bitou Bush) Invasion of native plant communities by exotic perennial grasses Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the REF proposal constitute or exacerbate a Key Threatening Process?	Confidence in assessment
Invasion and spread of weeds	Cooks River/Castlereagh Ironbark Forest, Freshwater Wetlands on Coastal Floodplains, River Flat Eucalypt Forest of Coastal Floodplains, Swamp Oak Floodplain Forest	Indirect	Local / Regional	Long term	<ul style="list-style-type: none"> • Invasion and establishment of exotic vines and scramblers • Invasion, establishment and spread of <i>Lantana camara</i> (Lantana) • Invasion of native plant communities by <i>Olea europaea subsp. cuspidate</i> (African Olive) • Invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (Bitou Bush) • Invasion of native plant communities by exotic perennial grasses • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. 	Known
Invasion and spread of pests	Applicable to all flora and fauna species and habitat	Indirect	Local / Regional	Long term	<ul style="list-style-type: none"> • Competition and grazing by the feral European rabbit (<i>Oryctolagus cuniculus</i>) • Competition and habitat degradation by feral goats (<i>Capra hircus</i>) • Herbivory and environmental degradation caused by feral deer • Invasion and establishment of the cane toad (<i>Bufo marinus</i>) • Predation and hybridisation of feral dogs (<i>Canis lupus familiaris</i>) • Predation by the European red fox (<i>Vulpes vulpes</i>) • Predation by the feral cat (<i>Felis catus</i>) • Predation by Plague Minnow or Mosquito Fish (<i>Gambusia holbrooki</i>) • Predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>) 	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the REF proposal constitute or exacerbate a Key Threatening Process?	Confidence in assessment
Invasion and spread of pathogens and disease	Applicable to all flora and fauna species and habitat	Indirect	Local / Regional	Long term	<ul style="list-style-type: none"> • Infection of native plants by <i>Phytophthora cinnamomi</i> • Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae • Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis 	Known
Groundwater dependent ecosystems	Swamp Sclerophyll Forest on Coastal Floodplain	Indirect - operational	Local	Long term	<ul style="list-style-type: none"> • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands 	Known
Changes to hydrology	Swamp Sclerophyll Forest on Coastal Floodplain	Direct/ indirect	Local	Long term	<ul style="list-style-type: none"> • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands 	Known
Noise, light and vibration	Applicable to all fauna species	Direct/ indirect	Local	Long term	N/A	Known

5 Avoid, minimise and mitigate impacts

In managing biodiversity, Transport aims to achieve a balanced outcome, taking account of environmental considerations together with economic and community objectives. This includes a balanced approach to examining the environmental consequences of an activity, recognising that achieving an optimal outcome often requires compromise and decisions regarding environmental values. A key part of Transport's management of biodiversity for the REF proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

1. Avoid and minimise impacts as the highest priority
2. Mitigate impacts where avoidance is not feasible or practicable in the circumstance
3. Offset where residual, significant unavoidable impacts would occur.

5.1 Avoidance and minimisation

Avoiding environmental impacts as the first step is consistent with the application of the precautionary principle. Transport for NSW's priority is to avoid impacts to the environment. This can be achieved by early consideration of environmental issues from identification of constraints at REF proposal inception through to options analysis and selection of a preferred option, design investigation and assessment of the preferred option, detailed design, and implementation of on-ground safeguards during construction and operation and maintenance of the activity.

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. In identifying suitable work sites, the first preference is to locate existing cleared and disturbed areas that have good access, are not within immediate proximity to waterways, and that support good site management practices (for example, management of material stockpiles). The REF proposal compound sites will be proposed in highly disturbed areas to avoid impacts to biodiversity, wherever possible. Design refinements would be undertaken in the detailed design phase with the aim to reduce the scope of the overall impact to biodiversity where possible. It is acknowledged that this assessment is based on a concept design and is indicative of the REF proposal's impact on biodiversity. As the design develops with ongoing gathering of site information (including ground survey and geotechnical survey), constructability assessments and stakeholder consultation there is potential for the REF proposal to change its overall disturbance footprint. Any increase in footprint will require this Biodiversity Assessment Report to be updated and biodiversity impacts to be re-evaluated in accordance with assessment guidelines outlined in Section 2.

5.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the REF proposal. Mitigation measures are to be undertaken during the construction and operational phases. The Transport guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of a project, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate.

The following mitigation measures as outlined in the Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects (NSW Roads and Traffic Authority, 2011) are recommended for implementation (see Table 5.1). The NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (Department of Primary Industries, 2013) has also been used.

Table 5.1 Proposed mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	<p>Native vegetation removal will be minimised through detailed design where possible.</p> <ul style="list-style-type: none"> • Placement of embankments and adopting alternative options such as retaining walls to minimise the construction footprint • Surveying the location of hollow bearing trees and including these on detailed design plans for further investigation in avoiding or minimising direct impacts 	Detailed design	Effective	The predicted residual impact to native vegetation species habitat is estimated at up to 1.69 ha.
	<p>Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p>	Prior to construction	Effective	
	<p>Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)</p>	During construction	Effective	
	<p>Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p>	Post construction	Effective	
	<p>Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011) and landscaping plans for the proposal.</p>	Prior to construction and during construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of threatened species habitat and habitat features	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened entities, not assessed in the biodiversity assessment, are identified in the REF proposal area.	During construction	Proven	The predicted residual impact to threatened species habitat is estimated at up to 1.69 ha of habitat.
	Opportunities to minimise impacts on Hollow-bearing trees, <i>Callistemon linearifolius</i> , and Threatened Ecological Communities will be investigated during detailed design. This will include ground survey locations of Hollow-bearing trees, <i>Callistemon linearifolius</i> and <i>Acacia pubescens</i> for inclusion onto design plans and integration into constructability assessments. Whilst no <i>Acacia pubescens</i> individuals would be impacted upon by the REF proposal the ground surveys would also target this species.	Detailed design	Effective	
	A targeted microbat survey of structures within the footprint and proposed for removal or modification would be undertaken in accordance with 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH, 2018b), prior to construction or as soon as feasible prior to disturbance. If threatened microbats are detected, a Microbat Management Plan would be developed as part of the Construction Environment Management Plan and implemented by a suitably qualified bat specialist.	Prior to construction and during construction	Effective	
	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and landscaping plans for the proposal.	Detailed design and during construction	Effective	
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Proven	
	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) or any updated approaches to tree hollow replacement such as relocated hollows or created hollows.	During construction	Proven	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Proven	No residual impact is anticipated
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the REF proposal area.	During construction	Proven	
Aquatic impacts	Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and <i>Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).	During construction	Effective	Minor, localised, modification to already highly disturbed habitat
	Consultation with NSW DPI Fisheries Regional Conservation Manager will be undertaken to discuss the best approach to construction works within aquatic habitats and riparian zones. Consulting before clearing will identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway.	Prior to construction	Effective	
	Access to the waterway minimises the removal of riparian vegetation and is restricted to the minimum amount of bank length required for the construction activity.	During construction	Effective	
	Design of the new Auld Avenue bridge will ensure that fish passage is not blocked.	Detailed design	Proven	
	In stream works to construct the new Auld Avenue bridge will ensure that fish passage is not blocked.	During construction	Proven	
	Riparian exclusion zones are marked out and managed according to <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) to protect aquatic habitats and riparian zones where works are not required.	During construction	Proven	
	Operational water quality controls are proposed to be installed for the overall proposal to reduce impacts from potential contaminants that maybe mobilised from the soil and/or groundwater. These will mitigate contaminants reaching the Georges River, including surrounding coastal wetlands.	During construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Groundwater dependent ecosystems	Interruptions to groundwater and surface water flows associated with groundwater dependent ecosystems, and impacts to GDEs, will be minimised through detailed design.	Detailed design	Effective	As per PCT impacts
	Disturbance of acid sulfate soils to be minimised during construction to prevent leaching into GDEs. Stormwater discharges to be managed to prevent sedimentation of GDE and toxicological impacts from potential contaminants. Sources of existing contaminants will be managed during construction through a Construction Contaminated Land Management Plan and by implementing the water quality strategy for the operational phase. The water quality strategy will be further developed in detailed design and in consultation with Canterbury-Bankstown City Council. An Acid sulfate and soil contamination management plan will be implemented to reduce the impact from the REF proposal.	During construction Detailed design	Effective	No residual impact is anticipated
Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design. The stormwater design for operational phase would aim to maintain, wherever possible, the existing flood regime and levels as identified by Lyall & Associates (2018).	Detailed design	Effective	Minor alteration to surface water flows and as per impacts to PCTs.
Wildlife corridors and connectivity	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). Removal of vegetation from the Georges River riparian zone will be minimised to the greatest extent practicable during detailed design. Where this is not possible, revegetation will be undertaken in accordance with landscaping plans that recommend a suitable planting palette for this riparian zone with further consideration to the selection of vegetation species that adopts existing communities and landscape character, and uses local provenance.	During construction	Effective	No residual impact is anticipated
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	No residual impact is anticipated

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Injury and mortality of fauna	<p>Opportunities to minimise road-kill will be identified in the design process with consideration to:</p> <ul style="list-style-type: none"> • Available space. • Avoid creating features too close to the roadside that would attract fauna to the roadside. • Using landscaping techniques to create suitable buffers and to separate any potential attracting features from the roadside. <p>A roadside planting palette that does not intentionally attract fauna to the roadside.</p>	Detailed design	Effective	Minor increase in potential vehicle strike during operation
	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	The mitigation measures should be effective, but injury or death may still occur
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011).	During construction	Proven	
Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
	The Landscaping Plan and the Construction Flora and Fauna Management Plan, the latter comprising a Weed Management Sub-Plan will be prepared in accordance with the DPI Office of Water Guidelines for Vegetation Management Plans on Waterfront Land (2012).	Prior to construction	Effective	None expected
Invasion and spread of pests	Pest species will be managed within the REF proposal area.	During construction	Effective	None expected
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Noise, light and vibration	Shading and artificial light impacts will be minimised where practicable taking into account minimum luminescence requirements for an urban road as outlined in the Australian Standards through detailed design.	Detailed design	Effective	Impacts from noise and light spill would remain

6 Offset strategy

6.1 Quantification of impacts

The need for biodiversity offsets is founded in the theory of ‘avoid, minimise and mitigate’ the impacts of proposals. The accepted approach to environmental assessment requires that, in the first instance, environmental impacts are avoided or minimised as far as possible and subsequently reduced to acceptable levels through appropriate mitigation techniques. Where measures to avoid and mitigate impacts are not feasible or cost effective, then offset strategies can be used to compensate the residual impacts of the development on biodiversity.

This biodiversity assessment report identifies that the REF proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (see Section 4.4 and Appendix D). In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

Transport would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in the Transport ‘Guideline for Biodiversity Offsets’ (Roads and Maritime Services, 2016). A comparison of the REF proposal’s residual impacts against the predetermined thresholds is provided in Table 6.1. The assessment indicates that offsets would be required for the REF proposal as the impacts exceed biodiversity offset thresholds.

An estimate of the quantum of offsets required in accordance with the simplified offset ratios within Table 2 of the Transport ‘Guideline for Biodiversity Offsets’ (Roads and Maritime Services, 2016) has been provided in Table 6.2.

Table 6.1 Transport for NSW offset thresholds

Description of activity or impact	Threshold: Consider offsets or supplementary measures	Does the REF proposal trigger an offset
Activities in accordance with Transport for NSW Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	No
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	No
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	No
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition	Yes. 0.21 ha of moderate condition PCT 725 and 0.96 ha of moderate condition PCT 835 is proposed for removal (combined = 1.17 ha)

Description of activity or impact	Threshold: Consider offsets or supplementary measures	Does the REF proposal trigger an offset
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Yes. 0.21 ha of moderate condition PCT 725 and 0.96 ha of moderate condition PCT 835 plus 0.10 of moderate condition PCT 1234 is proposed for removal. (combined = 1.27 ha) 1.17 ha of habitat for Swift Parrot, White-throated Needletail and Grey-headed Flying-fox.
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	No. <5ha of NSW TEC would be impacted upon and no TEC present is subject to a SIS.
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing > 1ha or where the species is the subject of an SIS	Yes. 1.27 ha of Southern Myotis habitat in moderate to good condition is proposed for removal Yes. Removal of 23 <i>Callistemon linearifolius</i>
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database (TSPD)	Where clearing > 5ha or where the species is the subject of an SIS	No. 1.27 ha of habitat in moderate to good condition for ecosystem credit fauna species is proposed for removal.
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	No

Implementation of the Transport *Guideline for Biodiversity Offsets* (RMS, November 2016) indicates that offsets are required for this REF proposal as the impacts exceed biodiversity offset thresholds. The biodiversity offset obligations would need to be re-evaluated during detailed design once a final disturbance footprint has been determined.

Table 6.2 Offset quantum based on REF proposal offset ratios

Type of impact	Offset ratio	REF proposal impact	Potential offset obligation
Loss of nationally listed TEC	Offset area of habitat lost at a ratio of 4:1	0.21 ha of moderate condition PCT 725 and 0.96 ha of moderate condition PCT 835 is proposed for removal (combined = 1.17 ha)	0.84 ha of PCT 725 and 3.84 ha of PCT 835 (combined 4.68 ha)
Loss of threatened fauna species	Offset area of habitat lost at a ratio of 3:1	1.17 ha of nationally listed threatened fauna species habitat in moderate to good condition	3.51 ha of habitat for Grey-headed Flying-fox, White-throated Needletail and Swift Parrot
		1.27 ha of NSW listed threatened species credit species habitat in moderate to good condition ¹	3.81 ha of habitat for Southern Myotis.
Loss of threatened flora species	Offset individuals lost at a ratio of 3:1	23 <i>Callistemon linearifolius</i>	69 <i>Callistemon linearifolius</i> individuals

Type of impact	Offset ratio	REF proposal impact	Potential offset obligation
NSW listed threatened species habitat and the species is an ecosystem credit species	Offset habitat lost at a ratio of 3:1	1.27 ha of habitat in moderate to good condition for ecosystem credit fauna species is proposed for removal.	3.81 ha of habitat for ecosystem credit fauna species.

6.1.1 Biodiversity Offset Scheme

The Biodiversity Offsets Scheme only applies to activities assessed and determined under Part 5 of the EP&A Act if proponents choose to 'opt in' to the Scheme. To satisfy the offset requirements for the proposal, Transport may consider participating in DPIE's Biodiversity Offset Scheme. The BAM calculator has been used to develop an indication of the likely offset requirement of the proposal which is presented in Table 6.3 and Table 6.4. The payment report that outlines the required offset and cost to satisfy the offset requirement for the proposal through payment into the Biodiversity Conservation Fund is provided in Appendix D. The cumulative offset requirement for the proposal and the EIS proposal are also presented in Table 6.3 and Table 6.4.

Table 6.3 Ecosystem credit requirement

Plant Community Type	Credits required for the REF proposal	Credits required for the EIS proposal	Cumulative total
PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	7	0	7
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	1	0	1
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	20	1	21
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	2	5	7
PCT 1236 Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0	1	1

Table 6.4 Species credit requirement

Species	Credits required for the REF proposal	Credits required for the EIS proposal	Cumulative total
Callistemon linearifolius (Netted Bottle Brush)	42	0	42
Myotis macropus (Southern Myotis)	30	8	38

7 Conclusion

This Biodiversity Assessment Report has been prepared to support a Review of Environmental Factors for the proposed upgrade of Henry Lawson Drive between Keys Parade and Tower Road, in NSW (the REF proposal).

Results of the field surveys and desk-based investigations completed identified six PCTs within the REF proposal area based on floristic composition, geological substrate and landscape position. These included:

- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – moderate condition
- PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 1236 - Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

In addition, two non-native vegetation type were assigned to miscellaneous ecosystem classes, being highly disturbed areas with no or limited native vegetation and urban/exotic plantings.

A total of four threatened ecological communities (TECs) listed under the BC Act and/or EPBC Act were recorded within the REF proposal study area. These are:

1. Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (BC/EPBC Acts)
2. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (BC Act)
3. River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC/EPBC Acts)
4. Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. (BC/EPBC Acts).

One threatened flora species, *Callistemon linearifolius* listed as vulnerable under the BC Act was recorded within the study area. *Callistemon linearifolius* will be affected by the REF proposal via the direct removal of approximately 23 individuals, with the six individuals growing in remnant bushland in Ashford Reserve to be protected.

Field surveys recorded one threatened fauna species utilising habitat within the study area including:

- Southern Myotis (*Myotis macropus*) listed as Vulnerable under the BC Act.

The overall outcome of the tests of significance and EPBC Act assessments of significance (see Appendix D) indicate that there is a high level of certainty that the impacts to threatened biodiversity are unlikely to be significant. Given the REF proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement (SIS) is not required under the BC Act to support this REF proposal.

This biodiversity assessment identified that the REF proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act. In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

Due to the relatively minor extent of excavations and the implementation of environmental groundwater safeguards it is unlikely that interception of groundwater flows would significantly affect groundwater dependent ecosystems within the study area. The REF proposal is not expected to substantially interfere with subsurface or groundwater flows associated with the Georges River.

There would be no impact to protected marine vegetation such as mangroves. The mapped Key Fish Habitat of the Georges River is outside of the REF proposal area so no direct impacts to mapped Key Fish Habitat will occur.

The Transport for NSW Guidelines for Biodiversity Offsets' (RMS, November 2016) indicates that the following offsets would be required by the REF proposal given residual impacts associated with the current development footprint exceed the predetermined thresholds as specified in the guideline:

- 4.68 ha of nationally listed TECs.
- 3.51 ha of habitat for EPBC Act listed species including Grey-headed Flying-fox and Swift Parrot
- 3.81 ha of habitat for BC Act listed species credit (fauna) species Southern Myotis
- 69 *Callistemon linearifolius* individuals.

A Biodiversity Offset Strategy would be developed during detailed design to identify biodiversity credits and/or supplementary measures for those entities impacted.

The cumulative area of impact on native vegetation that is likely to occur for both the REF proposal area and the EIS proposal area is 1.94 ha.

The Biodiversity Offsets Scheme only applies to activities assessed and determined under Part 5 of the EP&A Act if proponents choose to 'opt in' to the Scheme. To satisfy the offset requirements for the proposal, Transport may consider participating in DPIE's Biodiversity Offset Scheme in combination with the offset requirement for the EIS proposal. The BAM calculator has been used to develop an indication of the likely credit offset requirement of the cumulative impacts of the proposal and is summarised in Table 7.1 and Table 7.2 below.

Table 7.1 Ecosystem credit requirement

Plant Community Type	Credits required for the REF proposal	Credits required for the EIS proposal	Cumulative total
PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	7	0	7
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	1	0	1
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	20	1	21
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	2	5	7
PCT 1236 Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0	1	1

Table 7.2 Species credit requirement

Species	Credits required for the REF proposal	Credits required for the EIS proposal	Cumulative total
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	42	0	42
<i>Myotis macropus</i> (Southern Myotis)	30	8	38

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Appendix A – Species recorded

A1 – Recorded flora

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Acanthaceae	<i>Avicennia marina</i> subsp. <i>australasica</i>	Grey Mangrove															x		
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet					x	x											
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair					x												
Adiantaceae	<i>Cheilanthes distans</i>	Bristly cloak fern						x											
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Mulga fern			x			x											
Adiantaceae	<i>Pellaea viridis</i> *	Green Cliff Brake			x		x	x											
Agavaceae	<i>Yucca sp.</i> *	-											x						
Aizoaceae	<i>Tetragonia tetragonioides</i>	New Zealand Spinach							x					x			x	x	
Amaranthaceae	<i>Alternanthera philoxeroides</i> *	Alligator Weed				x								x					
Amaranthaceae	<i>Amaranthus viridis</i> *	Green Amaranth									x								
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily			x														
Apiaceae	<i>Centella asiatica</i>	Pennywort									x								
Apiaceae	<i>Hydrocotyle bonariensis</i> *	A Pennywort									x								
Apocynaceae	<i>Araujia sericifera</i> *	Moth Vine								x	x		x		x				
Apocynaceae	<i>Tylophora barbata</i>	Bearded Tylophora					x												
Arecaceae	<i>Syagrus romanzoffiana</i> *	Cocos palm											x						

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern											x			x			
Asparagaceae	<i>Asparagus asparagoides</i> *	Bridal Creeper			x		x	x		x			x						
Asphodelaceae	<i>Asphodelus fistulosus</i> *	Onion Weed									x	x							
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed													x				
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs					x		x	x	x	x	x	x		x		x	
Asteraceae	<i>Bidens subalternans</i> *	Greater Beggar's Ticks										x	x	x		x			
Asteraceae	<i>Cichorium intybus</i> *	Chicory										x							
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle					x			x	x	x							
Asteraceae	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane						x	x			x	x					x	
Asteraceae	<i>Conyza sp.</i> *	A Fleabane					x												
Asteraceae	<i>Conyza sumatrensis</i> *	Tall fleabane								x									
Asteraceae	<i>Hypochaeris radicata</i> *	Catsear										x		x					
Asteraceae	<i>Olearia microphylla</i>	Bridal Daisy Bush																	x
Asteraceae	<i>Ozothamnus diosmifolius</i>	Everlasting			x		x	x											
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed					x				x								
Asteraceae	<i>Soliva sessilis</i> *	Bindii												x					
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle					x		x	x	x	x		x				x	
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion								x		x							
Basellaceae	<i>Anredera cordifolia</i> *	Madeira Vine													x				
Bignoniaceae	<i>Jacaranda mimosifolia</i> *	Jacaranda								x				x					

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM	
Campanulaceae	<i>Lobelia purpurascens</i>	Whiteroot			x		x													
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell						x												
Caprifoliaceae	<i>Lonicera japonica</i> *	Japanese Honeysuckle										x								
Caryophyllaceae	<i>Stellaria media</i> *	Common Chickweed							x											
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black Sheoak			x															
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak						x	x	x	x		x	x		x	x	x		
Chenopodiaceae	<i>Atriplex prostrata</i> *																	x		
Chenopodiaceae	<i>Chenopodium album</i> *	Fat Hen																	x	
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush							x	x	x			x						
Chenopodiaceae	<i>Einadia polygonoides</i>	-					x													
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew				x	x				x									
Commelinaceae	<i>Tradescantia fluminensis</i> *	Wandering Jew				x			x	x			x	x	x				x	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed			x		x				x			x						x
Crassulaceae	<i>Bryophyllum delagoense</i> *	Mother of millions											x							
Cyperaceae	<i>Carex appressa</i>	Tall Sedge				x				x	x									
Cyperaceae	<i>Carex inversa</i>	Knob Sedge										x								
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge				x	x													
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge							x											
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge						x												
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge																		x

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Cyperaceae	<i>Lepidosperma gunnii</i>	-					x												
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge						x											
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower			x														
Epacridaceae	<i>Astroloma humifusum</i>	Native Cranberry			x														
Epacridaceae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath			x		x	x											
Euphorbiaceae	<i>Euphorbia peplus*</i>	Petty Spurge								x		x							
Fabaceae (Caesalpinioideae)	<i>Senna pendula</i> var. <i>glabrata*</i>	Easter Cassia				x		x											
Fabaceae (Caesalpinioideae)	<i>Senna septemtrionalis*</i>	-									x				x				
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	Broom Bitter Pea						x											
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender tick trefoil			x		x												
Fabaceae (Faboideae)	<i>Erythrina crista-galli*</i>	Cockspur Coral Tree				x	x								x				
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-			x		x				x								
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	-					x												
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla			x														
Fabaceae (Faboideae)	<i>Pultenaea villosa</i>	-			x														
Fabaceae (Faboideae)	<i>Trifolium repens*</i>	White Clover								x									
Fabaceae (Faboideae)	<i>Vicia sativa</i> subsp. <i>sativa*</i>	Common Vetch										x							
Fabaceae (Mimosoideae)	<i>Acacia binervia</i>	Coast Myall												x		x			

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Green Wattle						x	x	x	x					x			
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	-					x	x											
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle			x		x												
Fabaceae (Mimosoideae)	<i>Acacia parramattensis</i>	Parramatta Wattle			x				x					x					
Fabaceae (Mimosoideae)	<i>Acacia pubescens</i>	Downy wattle	V	V	x														
Fumariaceae	<i>Fumaria muralis</i> *								x				x						
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	Ivy Goodenia						x											
Iridaceae	<i>Freesia hybrid</i> *	Freesia			x			x											
Lauraceae	<i>Cassytha glabella</i>	Slender Devil's Twine								x									
Lauraceae	<i>Cassytha glabella</i> f. <i>glabella</i>	Slender Devil's Twine			x			x							x				
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel					x				x								
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	-			x		x												
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush			x		x	x											
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush					x	x											
Malvaceae	<i>Malva parviflora</i> *	Small-flowered Mallow												x					
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow					x		x		x								
Malvaceae	<i>Pavonia hastata</i> *	-			x														

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne					x	x	x	x	x	x	x	x					
Moraceae	<i>Morus sp.</i> *	Mulberry					x								x				
Myrsinaceae	<i>Anagallis arvensis</i> *	Scarlet/Blue Pimpernel									x	x							
Myrtaceae	<i>Angophora bakeri</i>	Narrow-leaved Apple			x														
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple			x			x								x			
Myrtaceae	<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush	V	-				x											
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum														x			
Myrtaceae	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>	Cabbage Gum									x								
Myrtaceae	<i>Eucalyptus baueriana</i>	Blue Box							x										
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark			x		x			x									
Myrtaceae	<i>Eucalyptus longifolia</i>	Woollybutt					x												
Myrtaceae	<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Parramatta Red Gum			x														
Myrtaceae	<i>Eucalyptus resinifera</i> subsp. <i>resinifera</i>	Red Mahogany														x			
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany														x			
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum								x	x					x			
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush			x			x											
Myrtaceae	<i>Melaleuca decora</i>	White Feather Myrtle					x		x					x		x			
Myrtaceae	<i>Melaleuca ericifolia</i>	Swamp Paperbark				x				x					x	x		x	x
Myrtaceae	<i>Melaleuca linariifolia</i>	Snow-in-Summer				x				x									x

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Myrtaceae	<i>Melaleuca nodosa</i>	Ball Honeymyrtle			x		x	x											
Myrtaceae	<i>Melaleuca sieberi</i>	-			x			x											
Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree							x	x				x		x			x
Myrtaceae	<i>Melaleuca thymifolia</i>	-						x											x
Ochnaceae	<i>Ochna serrulata</i> *	Mickey Mouse Plant														x			
Oleaceae	<i>Ligustrum lucidum</i> *	Large-leaved Privet												x		x			
Oleaceae	<i>Ligustrum sinense</i> *	Small-leaved Privet				x	x	x			x		x			x			
Oleaceae	<i>Notelaea longifolia</i> f. <i>longifolia</i>	Mock Olive					x												
Oleaceae	<i>Olea europaea</i> *	Common Olive						x			x			x					
Oxalidaceae	<i>Oxalis corniculata</i> *	Creeping Oxalis											x		x				
Oxalidaceae	<i>Oxalis perennans</i>	-					x			x									
Oxalidaceae	<i>Oxalis purpurea</i> *	Large-flowered Wood Sorrel					x				x		x						
Passifloraceae	<i>Passiflora subpeltata</i> *	White Passionflower			x		x	x			x				x	x			
Phormiaceae	<i>Dianella longifolia</i> var. <i>longifolia</i>	-			x		x	x											
Phytolaccaceae	<i>Phytolacca octandra</i> *	Inkweed					x												
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Native Blackthorn			x			x		x	x			x		x			
Plantaginaceae	<i>Plantago lanceolata</i> *	Lamb's Tongues								x	x	x							
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass			x			x											
Poaceae	<i>Aristida warburgii</i>	-						x											

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Poaceae	<i>Arundo donax</i> *	Giant Reed											x						
Poaceae	<i>Axonopus fissifolius</i> *	Narrow-leaved Carpet Grass										x							
Poaceae	<i>Bromus catharticus</i> *	Prairie Grass									x	x							
Poaceae	<i>Cenchrus clandestinus</i> *	Kikuyu Grass									x	x							
Poaceae	<i>Cynodon dactylon</i>	Common Couch					x	x			x	x							
Poaceae	<i>Dichelachne crinita</i>	Longhair Plumegrass					x												
Poaceae	<i>Digitaria sanguinalis</i> *	Summer Grass, Crab Grass										x							
Poaceae	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass					x												
Poaceae	<i>Ehrharta erecta</i> *	Panic Veldtgrass						x	x	x			x	x		x		x	
Poaceae	<i>Ehrharta longiflora</i> *	Annual Veldtgrass																x	
Poaceae	<i>Eleusine tristachya</i> *	Goose Grass										x							
Poaceae	<i>Entolasia marginata</i>	Bordered Panic				x													
Poaceae	<i>Entolasia stricta</i>	Wiry Panic			x		x												
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass					x												x
Poaceae	<i>Eragrostis curvula</i> *	African Lovegrass					x					x				x			x
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass					x												x
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass			x		x												

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass			x														
Poaceae	<i>Lolium perenne</i> *	Perennial Ryegrass																x	
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	-			x		x	x	x				x	x		x			
Poaceae	<i>Oplismenus aemulus</i>	-					x												
Poaceae	<i>Panicum maximum</i> var. <i>maximum</i> *	Guinea Grass									x			x					
Poaceae	<i>Paspalidium distans</i>	-			x														
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum										x							
Poaceae	<i>Phragmites australis</i>	Common Reed				x									x			x	
Poaceae	<i>Setaria parviflora</i> *	Slender Pigeon Grass			x		x	x					x						
Polygonaceae	<i>Acetosa sagittata</i> *	Turkey Rhubarb					x			x	x	x			x			x	
Polygonaceae	<i>Persicaria hydropiper</i>	Water Pepper				x													
Polygonaceae	<i>Persicaria lapathifolia</i>	Pale Knotweed				x													
Polygonaceae	<i>Rumex crispus</i> *	Curled Dock										x							
Primulaceae	<i>Aegiceras corniculatum</i>	River Mangrove															x	x	
Proteaceae	<i>Grevillea robusta</i>	Silky Oak													x				
Proteaceae	<i>Hakea sericea</i>	Needlebrush			x			x											
Ranunculaceae	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	Headache Vine			x		x												
Rosaceae	<i>Rubus fruticosus</i> agg.*	Blackberry											x		x				
Rubiaceae	<i>Opercularia varia</i>	Variable Stinkweed			x			x											
Sapindaceae	<i>Cardiospermum grandiflorum</i> *	Balloon Vine								x			x	x				x	

Family Name	Scientific Name ¹	Common Name	BC Act ²	EPBC Act ³	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Sapindaceae	<i>Guioa semiglauca</i>	-					x												
Scrophulariaceae	<i>Veronica plebeia</i>	Trailing Speedwell			x		x												
Solanaceae	<i>Cestrum parqui</i> *	Green Cestrum			x	x	x			x		x			x			x	
Solanaceae	<i>Solanum americanum</i>	Glossy Nightshade								x		x		x					
Solanaceae	<i>Solanum linnaeanum</i> *	Apple of Sodom																x	
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade					x		x	x	x							x	
Solanaceae	<i>Solanum pseudocapsicum</i> *	Madeira Winter Cherry					x				x								
Thymelaeaceae	<i>Pimelea linifolia</i>	Slender Rice-flower						x											
Typhaceae	<i>Typha orientalis</i>	Broad-leaved Cumbungi				x													
Urticaceae	<i>Parietaria judaica</i> *	Asthma Weed																x	
Verbenaceae	<i>Lantana camara</i> *	Lantana				x		x					x		x				
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop										x							
Vitaceae	<i>Cayratia clematidea</i>	Slender Grape							x										

A2 – Vegetation integrity plot data

Q1

Q1

PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Good condition

Species	Cover	Abundance	Covers							Exotic	HighThreat	Easting 313855	Northing 6243825	Zone 56	
			# spp 45	Native Count 38	Trees Count 6	Shrubs Count 12	Grass Count 8	Forb Count 6	Fern Count 1						Other Count 5
			Sum cover 93	Sum 88.8	Sum 16.8	Sum 42.6	Sum 19.4	Sum 4.3	Sum 1	Sum 4.7	Sum 4.2	Sum 2.1			
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	0.1	1	SG			0.1							80+	0	
<i>Acacia parramattensis</i>	0.8	4	TG		0.8								50-79	0	
<i>Acacia pubescens</i>	0.5	12	SG			0.5							30-49	Yes	
<i>Allocasuarina littoralis</i>	0.5	2	TG		0.5								20-29	Yes	
<i>Angophora bakeri</i>	0.5	1	TG		0.5								10-19	Yes	
<i>Angophora floribunda</i>	6	4	TG		6								5-9	Yes	
<i>Aristida vagans</i>	2	40	GG				2						<5	Yes	
<i>Asparagus asparagoides</i> *	2	30	HT										2		
<i>Astroloma humifusum</i>	0.1	2	SG			0.1							Hollows	0	
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	2	20	SG			2							Lenth of logs (m)	16.5	
<i>Cassylia glabella</i> f. <i>glabella</i>	0.6	10	OG							0.6					
<i>Cestrum parqui</i> *	0.1	1	HT										0.1		BAM Attributes 1x1m plot
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	1	100	EG						1						
<i>Clematis glycinoides</i> var. <i>glycinoides</i>	3	50	OG							3					Litter cover
<i>Desmodium varians</i>	0.1	2	OG							0.1					58
<i>Dianella longifolia</i> var. <i>longifolia</i>	0.3	10	FG						0.3						
<i>Dichondra repens</i>	1	80	FG						1						
<i>Entolasia stricta</i>	5	200	GG				5								
<i>Eriochloa pseudoacrotricha</i>	0.8	30	GG				0.8								
<i>Eucalyptus fibrosa</i>	1	1	TG		1										
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	8	2	TG		8										
<i>Freesia hybrid</i> *	0.4	20	EX								0.4				
<i>Glycine clandestina</i>	0.4	20	OG							0.4					
<i>Hakea sericea</i>	0.5	3	SG			0.5									
<i>Hardenbergia violacea</i>	0.6	10	OG							0.6					
<i>Hibbertia aspera</i>	0.1	3	SG			0.1									
<i>Imperata cylindrica</i> var. <i>major</i>	0.5	30	GG				0.5								
<i>Kunzea ambigua</i>	4	20	SG			4									
<i>Laxmannia gracilis</i>	0.1	5	FG						0.1						
<i>Leucopogon juniperinus</i>	5	20	SG			5									
<i>Lobelia purpurascens</i>	2	100	FG						2						
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.1	5	GG				0.1								
<i>Lomandra longifolia</i>	4	100	GG				4								
<i>Melaleuca nodosa</i>	30	80	SG			30									
<i>Melaleuca sieberi</i>	0.1	1	SG			0.1									
<i>Microlaena stipoides</i> var. <i>stipoides</i>	6	150	GG				6								
<i>Opercularia varia</i>	0.5	30	FG						0.5						
<i>Ozothamnus diosmifolius</i>	0.1	1	SG			0.1									

Q1

PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Good condition

Species	Cover	Abundance
<i>Paspalidium distans</i>	1	40
<i>Passiflora subpeltata</i> *	0.8	40
<i>Pavonia hastata</i> *	0.4	10
<i>Pellaea viridis</i> *	0.1	2
<i>Pultenaea villosa</i>	0.1	2
<i>Setaria parviflora</i> *	0.4	20
<i>Veronica plebeia</i>	0.4	30

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
45	38	6	12	8	6	1	5	7	2
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
93	88.8	16.8	42.6	19.4	4.3	1	4.7	4.2	2.1

Easting 313855
 Northing 6243825
 Orientation 260
 Zone 56

BAM Attributes
 20x50m plot
 Stem classes

GG				1					
EX								0.8	
EX								0.4	
EX								0.1	
SG			0.1						
EX								0.4	
FG					0.4				

Q2

Q2

PCT 1236: Swamp Paperbark -
Swamp Oak tall shrubland on
estuarine flats, Sydney Basin
Bioregion and South East Corner
Bioregion - Poor condition

Species	Cover	Abundance	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting 313573	Northing 6243803	Zone 56
				Count	Count	Count	Count	Count	Count	Count	Count	Count			
			# spp 16	8	0	2	3	3	0	0	8	8	Orientation		
			Sum cover 130.3	Sum 119.5	Sum 0	Sum 33	Sum 74	Sum 12.5	Sum 0	Sum 0	Sum 10.8	Sum 10.8	BAM Attributes 20x50m plot		
<i>Alternanthera philoxeroides</i> *	5	100	HT									5	80+	0	
<i>Carex appressa</i>	4	50	GG				4						50-79	0	
<i>Cestrum parqui</i> *	0.8	3	HT									0.8	30-49	No	
<i>Commelina cyanea</i>	0.5	30	FG					0.5					20-29	No	
<i>Cyperus eragrostis</i> *	0.1	2	HT										10-19	No	
<i>Erythrina crista-galli</i> *	1	1	HT										5-9	Yes	
<i>Lantana camara</i> *	0.4	5	HT										<5	Yes	
<i>Ligustrum sinense</i> *	0.1	1	HT												
<i>Melaleuca ericifolia</i>	30	12	SG			30							Hollows	0	
<i>Melaleuca linariifolia</i>	3	3	SG			3							Lenth of logs (m)	3	
<i>Persicaria hydropiper</i>	2	100	FG					2							
<i>Persicaria lapathifolia</i>	10	500	FG					10					BAM Attributes 1x1m plot		
<i>Phragmites australis</i>	65	500	GG				65								
<i>Senna pendula</i> var. <i>glabrata</i> *	0.4	2	HT										0.4	Litter cover	10
<i>Tradescantia fluminensis</i> *	3	100	HT										3		
<i>Typha orientalis</i>	5	100	GG				5								

Q3

Q3

PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Good condition

Species	Cover	Abundance
<i>Acacia falcata</i>	0.1	1
<i>Acacia longifolia subsp. longifolia</i>	0.1	1
<i>Acetosa sagittata*</i>	0.1	5
<i>Adiantum aethiopicum</i>	0.5	20
<i>Asparagus asparagoides*</i>	5	100
<i>Bidens pilosa*</i>	0.4	20
<i>Brunoniella australis</i>	0.1	5
<i>Cestrum parqui*</i>	0.1	1
<i>Cinnamomum camphora*</i>	0.1	1
<i>Cirsium vulgare*</i>	0.1	5
<i>Clematis glycinoides var. glycinoides</i>	2	50
<i>Commelina cyanea</i>	10	100
<i>Conyza sp.*</i>	0.4	10
<i>Cyperus eragrostis*</i>	0.1	3
<i>Desmodium varians</i>	0.1	2
<i>Dianella longifolia var. longifolia</i>	0.2	10
<i>Dichondra repens</i>	4	200
<i>Einadia polygonoides</i>	0.1	2
<i>Entolasia marginata</i>	10	300
<i>Entolasia stricta</i>	0.5	10
<i>Eriochloa pseudoacrotricha</i>	1	80
<i>Erythrina crista-galli*</i>	0.1	1
<i>Eucalyptus fibrosa</i>	12	9
<i>Eucalyptus longifolia</i>	15	11
<i>Glycine clandestina</i>	1	80
<i>Glycine tabacina</i>	0.6	50
<i>Guioa semiglauca</i>	0.4	10
<i>Lepidosperma gunnii</i>	0.2	10
<i>Leucopogon juniperinus</i>	0.6	10
<i>Ligustrum sinense*</i>	0.4	10
<i>Lobelia purpurascens</i>	5	200
<i>Lomandra filiformis subsp. filiformis</i>	0.1	1
<i>Lomandra longifolia</i>	2	50
<i>Lomandra multiflora subsp. multiflora</i>	0.6	40
<i>Melaleuca decora</i>	15	40
<i>Melaleuca nodosa</i>	25	200
<i>Microlaena stipoides var. stipoides</i>	5	100
<i>Modiola caroliniana*</i>	0.1	3
<i>Morus sp.*</i>	0.1	1
<i>Notelaea longifolia f. longifolia</i>	0.4	1

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
55	33	4	6	9	8	1	5	22	8
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
125.5	115.5	27.8	40.9	22.4	20.1	0.5	3.8	10	6

Easting 313716
Northing 6243827
Zone 56
Orientation 280

BAM Attributes
20x50m plot
Stem classes

80+ 0
50-79 0
30-49 Yes
20-29 Yes
Oct-19 Yes
5-9 Yes
<5 Yes

Hollows 0
Lenth of logs (m) 8.5

BAM Attributes
1x1m plot

Litter cover 79

Q3

PCT 725: Broad-leaved Ironbark -
Melaleuca decora shrubby open
forest on clay soils of the
Cumberland Plain, Sydney Basin
Bioregion – Good condition

Species	Cover	Abundance
<i>Oplismenus aemulus</i>	3	100
<i>Oxalis perennans</i>	0.5	30
<i>Oxalis purpurea*</i>	0.1	2
<i>Ozothamnus diosmifolius</i>	0.1	1
<i>Passiflora subpeltata*</i>	0.8	50
<i>Pellaea viridis*</i>	0.1	5
<i>Phytolacca octandra*</i>	0.2	5
<i>Senecio madagascariensis*</i>	0.1	1
<i>Setaria parviflora*</i>	1	80
<i>Sida rhombifolia*</i>	0.3	20
<i>Solanum nigrum*</i>	0.1	3
<i>Solanum pseudocapsicum*</i>	0.1	3
<i>Sonchus oleraceus*</i>	0.2	10
<i>Tylophora barbata</i>	0.1	1
<i>Veronica plebeia</i>	0.2	10

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
55	33	4	6	9	8	1	5	22	8
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
125.5	115.5	27.8	40.9	22.4	20.1	0.5	3.8	10	6

Easting 313716
Orientation
Northing 6243827
280
Zone 56

BAM Attributes
20x50m plot
Stem classes

GG				3					
FG					0.5				
EX								0.1	
SG			0.1						
EX								0.8	
EX								0.1	
EX								0.2	
HT									0.1
EX								1	
EX								0.3	
EX								0.1	
EX								0.1	
EX								0.2	
OG							0.1		
FG					0.2				

Q4

Q4

PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition (regrowth)

Species	Cover	Abundance	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting 313645 Orientation	Northing 6243901 280	Zone 56
				Count	Count	Count	Count	Count	Count	Count	Count	Count			
			# spp	35	3	12	12	5	2	1	12	6			
			47												
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum			
			89.7	43.4	3.8	22.4	14	1.2	1.2	0.8	46.3	41.6			
<i>Acacia decurrens</i>	2	10	TG		2								80+	0	
<i>Acacia falcata</i>	0.4	5	SG			0.4							50-79	0	
<i>Angophora floribunda</i>	1	3	TG		1								30-49	No	
<i>Aristida vagans</i>	2	80	GG				2						20-29	No	
<i>Aristida warburgii</i>	0.1	5	GG				0.1						10-19	No	
<i>Asparagus asparagoides*</i>	0.4	10	HT									0.4	5-9	Yes	
<i>Brunoniella australis</i>	0.1	2	FG					0.1					<5	Yes	
<i>Bursaria spinosa subsp. spinosa</i>	10	60	SG			10									
<i>Callistemon linearis</i>	0.3	7	SG			0.3							Hollows	0	
<i>Cassytha glabella f. glabella</i>	0.8	10	OG							0.8			Lenth of logs (m)	4	
<i>Casuarina glauca</i>	0.8	3	TG		0.8										
<i>Cheilanthes distans</i>	0.2	10	EG						0.2						
													BAM Attributes 1x1m plot		
<i>Cheilanthes sieberi subsp. sieberi</i>	1	100	EG						1						
<i>Conyza bonariensis*</i>	0.2	10	EX								0.2		Litter cover	37	
<i>Cynodon dactylon</i>	0.6	30	GG				0.6								
<i>Daviesia genistifolia</i>	0.1	1	SG			0.1									
<i>Dianella longifolia var. longifolia</i>	0.2	10	FG					0.2							
<i>Dichelachne crinita</i>	0.4	10	GG				0.4								
<i>Echinopogon caespitosus var. caespitosus</i>	0.6	20	GG				0.6								
<i>Eragrostis brownii</i>	0.4	30	GG				0.4								
<i>Eragrostis curvula*</i>	40	1000	HT									40			
<i>Eragrostis leptostachya</i>	8	200	GG				8								
<i>Fimbristylis dichotoma</i>	0.2	20	GG				0.2								
<i>Freesia hybrid*</i>	1	70	EX								1				
<i>Goodenia hederacea subsp. hederacea</i>	0.6	40	FG					0.6							
<i>Hakea sericea</i>	0.2	3	SG			0.2									
<i>Kunzea ambigua</i>	0.8	40	SG			0.8									
<i>Lantana camara*</i>	0.4	5	HT									0.4			
<i>Lepidosperma laterale</i>	0.4	20	GG				0.4								
<i>Leucopogon juniperinus</i>	3	30	SG			3									
<i>Ligustrum sinense*</i>	0.5	10	HT									0.5			
<i>Lomandra longifolia</i>	1	20	GG				1								
<i>Lomandra multiflora subsp. multiflora</i>	0.1	5	GG				0.1								
<i>Melaleuca nodosa</i>	5	50	SG			5									
<i>Melaleuca sieberi</i>	2	1	SG			2									
<i>Melaleuca thymifolia</i>	0.1	1	SG			0.1									
<i>Microlaena stipoides var. stipoides</i>	0.2	10	GG				0.2								
<i>Olea europaea*</i>	0.2	1	HT									0.2			

Q4

PCT 725: Broad-leaved Ironbark -
Melaleuca decora shrubby open forest
on clay soils of the Cumberland Plain,
Sydney Basin Bioregion – Moderate
condition (regrowth)

Species	Cover	Abundance
<i>Opercularia varia</i>	0.2	10
<i>Ozothamnus diosmifolius</i>	0.1	1
<i>Passiflora subpeltata</i> *	0.1	1
<i>Pellaea viridis</i> *	0.1	5
<i>Pimelea linifolia</i>	0.4	5
<i>Senna pendula var. glabrata</i> *	0.1	1
<i>Setaria parviflora</i> *	3	100
<i>Sida rhombifolia</i> *	0.3	20
<i>Wahlenbergia gracilis</i>	0.1	1

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp 47	35	3	12	12	5	2	1	12	6
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
89.7	43.4	3.8	22.4	14	1.2	1.2	0.8	46.3	41.6
	FG				0.2				
	SG		0.1						
	EX							0.1	
	EX							0.1	
	SG		0.4						
	HT								0.1
	EX							3	
	EX							0.3	
	FG				0.1				

Easting 313645
Northing 6243901
Zone 56
Orientation 280

BAM
Attributes
20x50m plot
Stem classes

Q7

Q7

VZ4 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)

Species

Cover Abundance

Acacia decurrens 0.4 2
Acacia parramattensis 10 12
*Bidens pilosa** 0.3 20
Casuarina glauca 3 5
Cayratia clematidea 3 40
*Conyza bonariensis** 0.2 10
Cynodon dactylon 3 80
Cyperus gracilis 0.1 5
*Ehrharta erecta** 8 100
Einadia hastata 0.6 10

Eucalyptus baueriana 38 16
*Fumaria muralis** 0.1 1

Melaleuca decora 1 1
Melaleuca styphelioides 20 30
Microlaena stipoides var. *stipoides* 0.8 40
*Modiola caroliniana** 0.1 5
*Sida rhombifolia** 0.2 20
*Solanum nigrum** 0.1 1
*Sonchus oleraceus** 0.1 2
*Stellaria media** 0.1 5
Tetragonia tetragonioides 10 50
*Tradescantia fluminensis** 2 40

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
22	12	4	2	3	2	0	1	10	2
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
101.1	89.9	51.4	21	3.9	10.6	0	3	11.2	10
<i>Acacia decurrens</i>		0.4							
<i>Acacia parramattensis</i>		10							
<i>Bidens pilosa</i> *								0.3	
<i>Casuarina glauca</i>		3							
<i>Cayratia clematidea</i>							3		
<i>Conyza bonariensis</i> *								0.2	
<i>Cynodon dactylon</i>				3					
<i>Cyperus gracilis</i>				0.1					
<i>Ehrharta erecta</i> *									8
<i>Einadia hastata</i>					0.6				
<i>Eucalyptus baueriana</i>		38							
<i>Fumaria muralis</i> *								0.1	
<i>Melaleuca decora</i>			1						
<i>Melaleuca styphelioides</i>			20						
<i>Microlaena stipoides</i> var. <i>stipoides</i>				0.8					
<i>Modiola caroliniana</i> *								0.1	
<i>Sida rhombifolia</i> *								0.2	
<i>Solanum nigrum</i> *								0.1	
<i>Sonchus oleraceus</i> *								0.1	
<i>Stellaria media</i> *								0.1	
<i>Tetragonia tetragonioides</i>					10				
<i>Tradescantia fluminensis</i> *									2

Easting 312766
 Northing 6245100
 Zone 56
 Orientation 168
 BAM Attributes 20x50m plot
 Stem classes
 80+ 1
 50-79 6
 30-49 No
 20-29 No
 10-19 No
 5-9 Yes
 <5 Yes
 Hollows 5
 Lenth of logs (m) 0
 BAM Attributes 1x1m plot
 Litter cover 62

Q12

Q12
 PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)

Species	Cover	Abundance
<i>Acacia decurrens</i>	4	10
<i>Acetosa sagittata*</i>	0.1	5
<i>Araujia sericifera*</i>	0.2	5
<i>Asparagus asparagoides*</i>	0.5	20
<i>Bidens pilosa*</i>	3	100
<i>Bursaria spinosa subsp. spinosa</i>	0.3	2
<i>Cardiospermum grandiflorum*</i>	15	50
<i>Carex appressa</i>	0.2	10
<i>Cassytha glabella</i>	0.1	1
<i>Casuarina glauca</i>	0.4	1
<i>Cestrum parqui*</i>	0.5	5
<i>Cirsium vulgare*</i>	0.4	10
<i>Conyza sumatrensis*</i>	0.8	30
<i>Ehrharta erecta*</i>	35	500
<i>Einadia hastata</i>	0.5	10
<i>Eucalyptus fibrosa</i>	3	3
<i>Eucalyptus tereticornis</i>	12	10
<i>Euphorbia peplus*</i>	0.8	80
<i>Jacaranda mimosifolia*</i>	0.4	1
<i>Melaleuca ericifolia</i>	0.1	1
<i>Melaleuca linariifolia</i>	7	4
<i>Melaleuca styphelioides</i>	22	15
<i>Oxalis perennans</i>	0.1	2
<i>Plantago lanceolata*</i>	0.1	5
<i>Sida rhombifolia*</i>	3	80
<i>Solanum americanum</i>	0.6	20
<i>Solanum nigrum*</i>	1	50
<i>Sonchus oleraceus*</i>	0.6	20
<i>Taraxacum officinale*</i>	0.4	20
<i>Tradescantia fluminensis*</i>	10	15
<i>Trifolium repens*</i>	0.4	10

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
31	13	4	4	1	3	0	1	18	7
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
122.5	50.3	19.4	29.4	0.2	1.2	0	0.1	72.2	61.3
TG		4							
HT									0.1
HT									0.2
HT								3	0.5
EX									10-19
SG			0.3						5-9
HT									15
GG				0.2					<5
OG							0.1		
TG		0.4							
HT									0.5
EX								0.4	
EX								0.8	
HT									35
FG					0.5				
TG		3							
TG		12							
EX								0.8	
EX								0.4	
SG			0.1						
SG			7						
SG			22						
FG					0.1				
EX								0.1	
EX								3	
FG					0.6				
EX								1	
EX								0.6	
EX								0.4	
HT									10
EX								0.4	

Eastings	Northing	Zone
313346	6243765	56
Orientation	90	
BAM Attributes		
20x50m plot		
Stem classes		
80+	0	
50-79	2	
30-49	No	
20-29	Yes	
10-19	Yes	
5-9	Yes	
<5	Yes	
Hollows	0	
Lenh of logs (m)	0	
BAM Attributes		
1x1m plot		
Litter cover	57	

Q18

Q18

PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)

Species	Cover	Abundance
<i>Acacia decurrens</i>	1	2
<i>Acetosa sagittata</i> *	0.2	5
<i>Amaranthus viridis</i> *	0.2	5
<i>Anagallis arvensis</i> *	0.1	5
<i>Araujia sericifera</i> *	0.4	10
<i>Asphodelus fistulosus</i> *	0.2	10
<i>Bidens pilosa</i> *	4	100
<i>Bromus catharticus</i> *	0.6	30
<i>Bursaria spinosa subsp. spinosa</i>	0.7	1
<i>Carex appressa</i>	0.3	10
<i>Casuarina glauca</i>	4	2
<i>Cenchrus clandestinus</i> *	3	60
<i>Centella asiatica</i>	1	80
<i>Cinnamomum camphora</i> *	1	1
<i>Cirsium vulgare</i> *	0.1	1
<i>Commelina cyanea</i>	5	100
<i>Cynodon dactylon</i>	2	50
<i>Dichondra repens</i>	2	100
<i>Ehrharta erecta</i> *	5	100
<i>Einadia hastata</i>	0.8	20
<i>Eucalyptus amplifolia subsp. amplifolia</i>	10	4
<i>Eucalyptus tereticornis</i>	25	28
<i>Glycine clandestina</i>	0.4	15
<i>Hydrocotyle bonariensis</i> *	0.2	5
<i>Ligustrum sinense</i> *	0.2	1
<i>Modiola caroliniana</i> *	0.4	10
<i>Olea europaea</i> *	0.1	1
<i>Oxalis purpurea</i> *	0.2	10
<i>Panicum maximum var. maximum</i> *	40	500
<i>Passiflora subpeltata</i> *	0.5	10
<i>Plantago lanceolata</i> *	0.4	20
<i>Senecio madagascariensis</i> *	0.1	1
<i>Senna septemtrionalis</i> *	0.1	1
<i>Sida rhombifolia</i> *	5	100
<i>Solanum nigrum</i> *	0.6	10
<i>Solanum pseudocapsicum</i> *	1	50
<i>Sonchus oleraceus</i> *	0.4	20

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
37	12	4	1	2	4	0	1	25	8
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
116.2	52.2	40	0.7	2.3	8.8	0	0.4	64	47
TG		1							
HT									0.2
EX								0.2	
EX								0.1	
HT									0.4
EX								0.2	
EX								4	
EX								0.6	
SG			0.7						
GG				0.3					
TG		4							
EX								3	
FG					1				
HT									1
EX								0.1	
FG					5				
GG				2					
FG					2				
HT									5
FG					0.8				
TG		10							
TG		25							
OG							0.4		
EX								0.2	
HT									0.2
EX								0.4	
HT									0.1
EX								0.2	
EX									40
EX								0.5	
EX								0.4	
HT									0.1
EX								0.1	
EX								5	
EX								0.6	
EX								1	
EX								0.4	

Easting 313306
 Northing 6243717
 Zone 56
 Orientation 320

BAM Attributes
 20x50m plot
 Stem classes
 80+ 1
 50-79 6
 30-49 Yes
 20-29 Yes
 10-19 Yes
 5-9 Yes
 <5 Yes

Hollows 5
 Lenth of logs (m) 10

BAM Attributes
 1x1m plot
 Litter cover 74

Q19

Q19
Miscellaneous ecosystem -
Weeds / exotics – non-
native vegetation

Species

Cover **Abundance**

# spp	Covers								
	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
32	Count	Count	Count	Count	Count	Count	Count	Count	Count
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
	3	0	0	2	1	0	0	29	6
95.9	10.3	0	0	10.2	0.1	0	0	85.6	48.3
<i>Acetosa sagittata</i> *	0.4	5	HT						0.4
<i>Anagallis arvensis</i> *	0.2	10	EX					0.2	
<i>Asphodelus fistulosus</i> *	0.1	5	EX					0.1	
<i>Axonopus fissifolius</i> *	2	80	HT						2
<i>Bidens pilosa</i> *	0.8	40	EX					0.8	
<i>Bidens subalternans</i> *	0.3	20	EX					0.3	
<i>Bromus catharticus</i> *	0.1	5	EX					0.1	
<i>Carex inversa</i>	0.2	10	GG	0.2					
<i>Cenchrus clandestinus</i> *	10	80	EX					10	
<i>Cestrum parqui</i> *	0.4	2	HT						0.4
<i>Cichorium intybus</i> *	0.1	1	EX					0.1	
<i>Cirsium vulgare</i> *	0.1	2	EX					0.1	
<i>Conyza bonariensis</i> *	0.6	30	EX					0.6	
<i>Cynodon dactylon</i>	10	100	GG	10					
<i>Digitaria sanguinalis</i> *	2	30	EX					2	
<i>Eleusine tristachya</i> *	0.2	10	EX					0.2	
<i>Eragrostis curvula</i> *	10	100	HT						10
<i>Euphorbia peplus</i> *	0.1	10	EX					0.1	
<i>Fumaria muralis</i> *	0.4	10	EX					0.4	
<i>Hypochaeris radicata</i> *	3	100	EX					3	
<i>Lonicera japonica</i> *	0.5	5	HT						0.5
<i>Oxalis corniculata</i> *	0.1	5	EX					0.1	
<i>Paspalum dilatatum</i> *	35	500	HT						35
<i>Plantago lanceolata</i> *	0.6	30	EX					0.6	
<i>Rumex crispus</i> *	0.1	1	EX					0.1	
<i>Setaria parviflora</i> *	15	200	EX					15	
<i>Sida rhombifolia</i> *	0.6	20	EX					0.6	
<i>Solanum americanum</i>	0.1	1	FG		0.1				
<i>Sonchus oleraceus</i> *	0.5	30	EX					0.5	
<i>Taraxacum officinale</i> *	1	80	EX					1	
<i>Verbena bonariensis</i> *	1	40	EX					1	
<i>Vicia sativa subsp. sativa</i> *	0.4	80	EX					0.4	

Easting 313174
Northing 6243566
Zone 56
Orientation 70
BAM Attributes
20x50m plot
Stem classes
80+ 0
50-79 0
30-49 No
20-29 No
10-19 No
5-9 No
<5 No
Hollows 0
Lenth of logs (m) 0
BAM Attributes
1x1m plot
Litter cover 10

Q20

Q20
 PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition

Species	Cover	Abundance
<i>Araujia sericifera</i> *	0.3	10
<i>Arundo donax</i> *	10	20
<i>Asparagus aethiopicus</i> *	0.1	1
<i>Asparagus asparagoides</i> *	0.8	10
<i>Bidens pilosa</i> *	0.3	20
<i>Bidens subalternans</i> *	0.1	5
<i>Bryophyllum delagoense</i> *	0.3	5
<i>Cardiospermum grandiflorum</i> *	55	100
<i>Casuarina glauca</i>	35	50
<i>Conyza bonariensis</i> *	0.1	1
<i>Ehrharta erecta</i> *	15	100
<i>Lantana camara</i> *	0.1	5
<i>Ligustrum sinense</i> *	0.1	1
<i>Microlaena stipoides</i> var. <i>stipoides</i>	0.2	20
<i>Oxalis purpurea</i> *	0.1	2
<i>Rubus fruticosus</i> agg.*	0.5	5
<i>Sida rhombifolia</i> *	0.4	20
<i>Syagrus romanzoffiana</i> *	0.6	1
<i>Tradescantia fluminensis</i> *	10	100
<i>Yucca sp.</i> *	15	30

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
20	2	1	0	1	0	0	0	18	11
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
144	35.2	35	0	0.2	0	0	0	108.8	92.2

Easting	313095	Northing	6243534	Zone	56
Orientation			250		
BAM Attributes					
20x50m plot					
Stem classes					
80+					0
50-79					0
30-49					No
20-29					Yes
10-19					Yes
5-9					Yes
<5					Yes
Hollows					0
Lenth of logs (m)					5
BAM Attributes					
1x1m plot					
Litter cover					70

Q21

Q21
 PCT 1234: Swamp Oak
 Swamp Forest Fringing
 Estuaries, Sydney Basin and
 South East Corner – Moderate
 condition

Species	Cover	Abundance
<i>Acacia binervia</i>	10	3
<i>Acacia parramattensis</i>	15	30
<i>Alternanthera philoxeroides*</i>	0.1	2
<i>Bidens pilosa*</i>	0.8	20
<i>Bidens subalternans*</i>	0.4	10
<i>Bursaria spinosa subsp. spinosa</i>	1	4
<i>Cardiospermum grandiflorum*</i>	0.4	5
<i>Casuarina glauca</i>	40	60
<i>Dichondra repens</i>	0.4	50
<i>Ehrharta erecta*</i>	25	500
<i>Einadia hastata</i>	3	20
<i>Hypochaeris radicata*</i>	0.4	10
<i>Jacaranda mimosifolia*</i>	0.1	1
<i>Ligustrum lucidum*</i>	1	1
<i>Malva parviflora*</i>	0.5	10
<i>Melaleuca decora</i>	10	8
<i>Melaleuca styphelioides</i>	1	2
<i>Microlaena stipoides var. stipoides</i>	5	100
<i>Olea europaea*</i>	0.8	1
<i>Oxalis corniculata*</i>	0.8	50
<i>Panicum maximum var. maximum*</i>	1	30
<i>Sida rhombifolia*</i>	0.4	10
<i>Solanum americanum</i>	0.6	15
<i>Soliva sessilis*</i>	0.1	5
<i>Sonchus oleraceus*</i>	0.6	20
<i>Tetragonia tetragonoides</i>	0.6	4
<i>Tradescantia fluminensis*</i>	10	150

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
27	11	3	3	1	4	0	0	16	7
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
	86.6	65	12	5	4.6	0	0	42.4	38.3

Easting	313235	Northing	6244032	Zone	56
Orientation			20		
BAM Attributes					
20x50m plot					
Stem classes					
80+			0		
50-79			1		
30-49		0.1	Yes		
20-29			Yes		
10-19			Yes		
5-9			Yes		
<5		0.4	Yes		
Hollows			0		
Lenth of logs (m)		25	21		
BAM Attributes					
1x1m plot					
Litter cover			47		

Q24

Q24
 PCT 835: Forest Red Gum-
 Rough-barked Apple Grassy
 Woodland on Alluvial Flats of
 the Cumberland Plain, Sydney
 Basin – Moderate condition
 (Forest Red Gum variant)

Species	Cover	Abundance
<i>Acacia binervia</i>	2	4
<i>Acacia decurrens</i>	0.6	3
<i>Angophora floribunda</i>	12	5
<i>Asparagus aethiopicus*</i>	0.1	2
<i>Bidens pilosa*</i>	0.3	20
<i>Bidens subalternans*</i>	0.1	3
<i>Bursaria spinosa subsp. spinosa</i>	0.5	3
<i>Casuarina glauca</i>	0.4	10
<i>Corymbia maculata</i>	15	5
<i>Ehrharta erecta*</i>	0.5	20
<i>Eragrostis curvula*</i>	85	500
<i>Eucalyptus resinifera subsp. resinifera</i>	7	1
<i>Eucalyptus robusta</i>	8	3
<i>Eucalyptus tereticornis</i>	3	1
<i>Ligustrum lucidum*</i>	1	2
<i>Ligustrum sinense*</i>	0.2	1
<i>Melaleuca decora</i>	0.4	3
<i>Melaleuca ericifolia</i>	0.1	1
<i>Melaleuca styphelioides</i>	0.1	1
<i>Microlaena stipoides var. stipoides</i>	0.6	20
<i>Ochna serrulata*</i>	0.1	1
<i>Passiflora subpeltata*</i>	0.4	10

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
22	13	8	4	1	0	0	0	9	6
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
137.4	49.7	48	1.1	0.6	0	0	0	87.7	86.9
<i>Acacia binervia</i>		2							
<i>Acacia decurrens</i>		0.6							
<i>Angophora floribunda</i>		12							
<i>Asparagus aethiopicus*</i>									
<i>Bidens pilosa*</i>								0.3	
<i>Bidens subalternans*</i>								0.1	
<i>Bursaria spinosa subsp. spinosa</i>			0.5						
<i>Casuarina glauca</i>		0.4							
<i>Corymbia maculata</i>		15							
<i>Ehrharta erecta*</i>									0.5
<i>Eragrostis curvula*</i>									85
<i>Eucalyptus resinifera subsp. resinifera</i>		7							
<i>Eucalyptus robusta</i>		8							
<i>Eucalyptus tereticornis</i>		3							
<i>Ligustrum lucidum*</i>									1
<i>Ligustrum sinense*</i>									0.2
<i>Melaleuca decora</i>			0.4						
<i>Melaleuca ericifolia</i>			0.1						
<i>Melaleuca styphelioides</i>			0.1						
<i>Microlaena stipoides var. stipoides</i>				0.6					
<i>Ochna serrulata*</i>									0.1
<i>Passiflora subpeltata*</i>								0.4	

Easting	313291	Northing	6243933	Zone	56
Orientation			315		
BAM Attributes					
20x50m plot					
Stem classes					
80+			0		
50-79			5		
30-49			Yes		
20-29		0.1	Yes		
10-19			Yes		
5-9			Yes		
<5			Yes		
Hollows			0		
Lenth of logs (m)			0		
BAM Attributes					
1x1m plot					
Litter cover			60		

Q25

Q25
 PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Good condition

Species	Cover	Abundance
<i>Aegiceras corniculatum</i>	45	30
<i>Atriplex prostrata*</i>	0.3	5
<i>Avicennia marina subsp. australasica</i>	60	50
<i>Casuarina glauca</i>	2	3
<i>Tetragonia tetragonioides</i>	0.8	20

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
5	4	2	1	0	1	0	0	1	0
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
108.1	107.8	62	45	0	0.8	0	0	0.3	0

Easting	313217	Northing	6244086	Zone	56
Orientation			310		
BAM Attributes					
20x50m plot					
Stem classes					
	80+		0		
	50-79		0		
	30-49		No		
	20-29		No		
	10-19		No		
	5-9		No		
	<5		No		
Hollows			2		
Lenth of logs (m)			11		
BAM Attributes					
1x1m plot					
Litter cover			1.6		

Q26

Q26
 PCT 1800: Swamp Oak
 open forest on riverflats of
 the Cumberland Plain and
 Hunter valley – Poor
 condition

Species

Cover Abundance

		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		19	5	1	2	1	1	0	0	14	6
		Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
		143.7	81	40	0.9	0.1	40	0	0	62.7	60.9
<i>Acetosa sagittata*</i>	0.1	10	HT								0.1
<i>Aegiceras corniculatum</i>	0.5	5	SG		0.5						
<i>Bidens pilosa*</i>	0.2	20	EX						0.2		
<i>Cardiospermum grandiflorum*</i>	0.1	1	HT							0.1	
<i>Casuarina glauca</i>	40	100	TG	40							
<i>Cestrum parqui*</i>	0.5	5	HT							0.5	
<i>Chenopodium album*</i>	0.1	1	EX						0.1		
<i>Conyza bonariensis*</i>	0.1	1	EX						0.1		
<i>Ehrharta erecta*</i>	30	500	HT							30	
<i>Ehrharta longiflora*</i>	0.1	2	EX						0.1		
<i>Lolium perenne*</i>	0.1	10	EX						0.1		
<i>Melaleuca ericifolia</i>	0.4	5	SG		0.4						
<i>Parietaria judaica*</i>	0.2	2	HT								0.2
<i>Phragmites australis</i>	0.1	1	GG			0.1					
<i>Solanum linnaeanum*</i>	0.5	5	EX							0.5	
<i>Solanum nigrum*</i>	0.5	5	EX							0.5	
<i>Sonchus oleraceus*</i>	0.2	20	EX							0.2	
<i>Tetragonia tetragonioides</i>	40	600	FG				40				
<i>Tradescantia fluminensis*</i>	30	500	HT								30

Easting 313011
 Northing 6244397
 Zone 56
 Orientation 139
 BAM Attributes
 20x50m plot
 Stem classes
 80+ 0
 50-79 3
 30-49 Yes
 20-29 Yes
 10-19 Yes
 5-9 Yes
 <5 Yes
 Hollows 1
 Lenth of logs (m) 0
 BAM Attributes
 1x1m plot
 Litter cover 40

A3 – Recorded fauna

Scientific Name	Common Name	Native (N) or Introduced (I)	BC Act Status ¹	EPBC Act Status ²
Amphibians				
<i>Crinia signifera</i>	Common Eastern Froglet	N	-	-
<i>Limnodynastes peronii</i>	Striped Marsh frog	N	-	-
<i>Litoria dentata</i>	Bleating Tree frog	N	-	-
<i>Litoria fallax</i>	Eastern Dwarf Tree frog	N	-	-
<i>Litoria peronii</i>	Peron's Tree Frog	N	-	-
<i>Litoria tylerii</i>	Tyler's Tree frog	N	-	-
Birds				
<i>Acanthiza pusilla</i>	Brown Thornbill	N	-	-
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	N	-	-
<i>Acridotheres tristis</i>	Common Myna*	I	-	-
<i>Anas superciliosa</i>	Pacific Black Duck	N	-	-
<i>Anser anser domesticus</i>	Goose	N	-	-
<i>Anthochaera carunculata</i>	Red Wattlebird	N	-	-
<i>Aythya australis</i>	Hardhead	N	-	-
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	N	-	-
<i>Cacatua sanguinea</i>	Little Corella	N	-	-
<i>Chenonetta jubata</i>	Australian Wood Duck	N	-	-
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	N	-	-
<i>Columba livia</i>	Rock Dove*	I	-	-
<i>Corvus coronoides</i>	Australian Raven	N	-	-
<i>Cracticus torquatus</i>	Grey Butcherbird	N	-	-
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	N	-	-
<i>Egretta novaehollandiae</i>	White-faced Heron	N	-	-
<i>Eolophus roseicapilla</i>	Galah	N	-	-
<i>Eopsaltria australis</i>	Eastern Yellow Robin	N	-	-
<i>Fulica atra</i>	Eurasian Coot	N	-	-
<i>Gallinula tenebrosa</i>	Dusky Moorhen	N	-	-
<i>Glossopsitta concinna</i>	Musk Lorikeet	N	-	-
<i>Grallina cyanoleuca</i>	Magpie-lark	N	-	-
<i>Gymnorhina tibicen</i>	Australian Magpie	N	-	-
<i>Hirundo neoxena</i>	Welcome Swallow	N	-	-
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	N	-	-
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	N	-	-
<i>Malurus cyaneus</i>	Superb Fairy-wren	N	-	-
<i>Manorina melanocephala</i>	Noisy Miner	N	-	-
<i>Manorina melanophrys</i>	Bell Miner	N	-	-
<i>Mesophoyx intermedia</i>	Intermediate Egret	N	-	-

Scientific Name	Common Name	Native (N) or Introduced (I)	BC Act Status ¹	EPBC Act Status ²
<i>Neochmia temporalis</i>	Red-browed Finch	N	-	-
<i>Ocyphaps lophotes</i>	Crested Pigeon	N	-	-
<i>Pachycephala pectoralis</i>	Golden Whistler	N	-	-
<i>Pachycephala rufiventris</i>	Rufous Whistler	N	-	-
<i>Pardalotus punctatus</i>	Spotted Pardalote	N	-	-
<i>Pelecanus conspicillatus</i>	Australian Pelican	N	-	-
<i>Phalacrocorax carbo</i>	Great Cormorant	N	-	-
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	N	-	-
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	N	-	-
<i>Platycercus eximius</i>	Eastern Rosella	N	-	-
<i>Porphyrio porphyrio</i>	Purple Swamphen	N	-	-
<i>Psephotus haematonotus</i>	Red-rumped Parrot	N	-	-
<i>Psophodes olivaceus</i>	Eastern Whipbird	N	-	-
<i>Pycnonotus jocosus</i> *	Red-whiskered Bulbul*	I	-	-
<i>Rhipidura albiscapa</i>	Grey Fantail	N	-	-
<i>Rhipidura leucophrys</i>	Willie Wagtail	N	-	-
<i>Sericornis frontalis</i>	White-browed Scrubwren	N	-	-
<i>Strepera graculina</i>	Pied Currawong	N	-	-
<i>Streptopelia chinensis</i> *	Spotted Dove*	I	-	-
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	N	-	-
<i>Threskiornis molucca</i>	Australian White Ibis	N	-	-
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	N	-	-
<i>Vanellus miles</i>	Masked Lapwing	N	-	-
<i>Zosterops lateralis</i>	Silvereye	N	-	-
Mammals				
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	N	-	-
<i>Myotis macropus</i>	Southern Myotis	N	V	-
<i>Pseudocheirus peregrinus</i>	Ring-tail Possum	N	-	-
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	N	V	V
<i>Rattus rattus</i> *	Black Rat*	I	-	-
<i>Tadarida australis</i>	White-striped free-tailed Bat	N	-	-
<i>Trichosurus vulpecula</i>	Brush-tail Possum	N	-	-
<i>Vulpes Vulpes</i>	Fox*	I	-	-
Reptiles				
<i>Lampropholis delicata</i>	Delicate Skink	N	-	-
<i>Physignathus lesueurii</i>	Eastern Water-dragon	N	-	-

(1) BC Act status: threatened species status under the *Biodiversity Conservation Act 2016*

(2) EPBC Act status: threatened species status under the Environment Protection and Biodiversity Conservation Act 1999.

Appendix B – Habitat assessment tables

B1 – Habitat assessment table – threatened flora species

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Acacia bynoeana</i> (Bynoes Wattle)	E1	V	No	Occurs south of Dora Creek-Morriset 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 (Harden 2002). Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with <i>Corymbia gummifera</i> , <i>Eucalyptus haemastoma</i> , <i>E. gummifera</i> , <i>E. parramattensis</i> , <i>E. sclerophylla</i> , <i>Banksia serrata</i> and <i>Angophora bakeri</i> (NSW National Parks and Wildlife Service 1999)	PMST, Bionet, PlantNet, BAM-C	Moderate - Few records within the locality, preferred habitat (sandy soils) is not recorded within the study area. Based on the presence of PCT 725 this species was considered a candidate species. Not recorded during targeted surveys.	No – surveyed
<i>Acacia prominens</i>	E2	-	No	Occurs on clay, loam or sand soils, often requiring a moist, protected habitat in wet sclerophyll forest (Royal Botanic Gardens 2008). The Endangered population is restricted to the Hurstville and Kogarah LGAs and consist of isolated trees from a few sites at Penshurst and Oatley (Department of Environment and Climate Change 2008).	BioNet, BAM C	Low – Few records within the locality, preferred habitat is not recorded within the study area.	No
<i>Acacia pubescens</i> (Downy Wattle)	V	V	No	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 gravelly soils often with ironstones (Harden, 2002 (Department of Planning Industry and Environment, 2020).	BioNet, PMST, PlantNet	Recorded – Species is known to occur in study area (GHD, 2014) and was recorded during field surveys. This species is considered further within the body of the report..	Yes
<i>Allocasuarina glareicola</i>	E2	-	No	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool (Office of Environment & Heritage 2018). Grows on lateritic soil in open forest (Harden 2000).	BioNet PMS, PlantNet	Moderate - Known distribution primarily restricted to Richmond. Not recorded during targeted surveys.	No - surveyed

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Asterolasia elegans</i>	E1	E	Yes	Known from only seven populations, north of Sydney in the Baulkham Hills, Hawkesbury and Hornsby LGAs; also likely to occur in the western part of Gosford LGA. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>), Smooth-barked Apple (<i>Angophora costata</i>), Sydney Peppermint (<i>Eucalyptus piperita</i>), Forest Oak (<i>Allocasuarina torulosa</i>) and Christmas Bush (<i>Ceratopetalum gummiiferum</i>).	PMST	Low - This species is known to occur on Hawkesbury Sandstone in sheltered forest of which no suitable habitat was recorded within the study area. The study area is outside its known distribution.	No
<i>Caesia parviflora</i> var. <i>minor</i> (Small Pale Grass-lily)	E1	-	No	Occurs south from Corindi area where it grows in heath woodland and dry sclerophyll forest on sandstone derived soils. Found in damp places in open forest.	BioNet	Low - This species has a low likelihood of occurring within the study area. Study area not within known distribution.	No
<i>Caladenia tessellata</i> (Thick Lip Spider Orchid)	E1	V	Yes	Occurs south of Swansea where it grows on clay loam or sandy soils (Harden 1993). Prefers low open forest with a heathy or sometimes grassy understorey (Bishop 2000). 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 (NSW Scientific Committee 2002).	PMST BAM-C	Moderate - No records within the locality. Included as a candidate species based on the presence of PCT 725. Not recorded during targeted surveys.	No - surveyed
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	V	-	No	Occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies (Robinson 1994, Fairley and Moore 2002, Harden 2002). Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (NSW Scientific Committee 1999).	BioNet, PlantNet BAM-C	Recorded – <i>Callistemon linearifolius</i> was recorded during field surveys. Material was collected to confirm identification. Previously recorded within the locality. Closest record near the intersection of Milperra Rd and Henry Lawson Drive. This species is considered further within the body of the report.	Yes

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Cryptostylis hunteriana</i> (Leafless Tongue Orchid)	V	V	No	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 (Department of Planning Industry and Environment, 2020).	PMST	Low - Preferred habitat is not recorded within the study area. No records within the locality.	No
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	E1	E	No	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes. This species typically occurs at the ecotone between dry subtropical forest/woodland communities (Department of Planning Industry and Environment, 2020).	PMST BAM-C	Low - This species is known to occur rainforest gullies, scrub and scree slope habitats at ecotones between sub dry subtropical forest/woodland. This habitat does not occur within the study area.	No
<i>Darwinia biflora</i>	V	V	No	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. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include Eucalyptus haemastoma, Corymbia gummifera and/or E. squamosa. The vegetation structure is usually woodland, open forest or scrub-heath.	PMST	Low – Preferred habitat is not recorded within the study area.	No
<i>Deyeuxia appressa</i>	E1	E	Yes	Highly restricted, known only from two pre-1942 records in the Sydney area; in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown and in 1941 from Killara, near Hornsby. It has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas. Flowers spring to summer and is mesophytic (grows in moist conditions). But, given that it hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology (Office of Environment & Heritage 2012).	BioNet, PMST, PlantNet BAM-C	Low - Highly restricted, known only from two pre-1942 records. Species has not been recorded for 60 years	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Dillwynia tenuifolia</i>	V, E2	-	No	In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. At Yengo, is reported to occur in disturbed escarpment woodland on Narrabeen sandstone. <i>Eucalyptus fibrosa</i> is usually the dominant canopy species. <i>Eucalyptus globoidea</i> , <i>E. longifolia</i> , <i>E. parramattensis</i> , <i>E. sclerophylla</i> and <i>E. sideroxylon</i> may also be present or codominant, with <i>Melaleuca decora</i> frequently forming a secondary canopy layer. Associated species may include <i>Allocasuarina littoralis</i> , <i>Angophora bakeri</i> , <i>Aristida</i> spp. <i>Banksia spinulosa</i> , <i>Cryptandra</i> spp. <i>Daviesia ulicifolia</i> , <i>Entolasia stricta</i> , <i>Hakea sericea</i> , <i>Lissanthe strigosa</i> , <i>Melaleuca nodosa</i> , <i>Ozothamnus diosmifolius</i> and <i>Themeda australis</i> . The shrub layer is dominated by <i>D. tenuifolia</i> , <i>Leucopogon muticus</i> , <i>Leptospermum parvifolium</i> and <i>Pultenaea microphylla</i> .	BAM-C	Moderate – No records within locality, preferred habitat does not occur. Included as a candidate species based on the presence of PCT 725. Not recorded during targeted surveys.	No - surveyed
<i>Diuris aequalis</i> (Buttercup Doubletail)	E1	V	No	Occurs chiefly in the ranges and tablelands from Braidwood to Kanangra and Liverpool where it grows among grass in sclerophyll forest. It typically occurs on gentle slopes, in gravely clay-loam soil within montane eucalypt forest with a grass or heath understorey. Three small populations are known to occur within Kanangra Boyd National Park, other populations are restricted to remnant vegetation within roadsides and agricultural lands.	BioNet	Low - Preferred habitat is not recorded within the study area. No records within the locality.	No
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	V	-	No	Occurs in Gosford and Sydney districts where it grows in sclerophyll forest, scrub and swamps (Harden 1992). Usually found in sites with a strong shale influence (NSW National Parks and Wildlife Service 2002).	BioNet, PMST, PlantNet BAM-C	Moderate - Potential habitat within the study area. Closest records at Rockwood. Not recorded during targeted surveys.	No - surveyed
<i>Eucalyptus benthami</i> (Camden White Gum)	V	V	No	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty, with a further stand at Werriberri (Monkey) Creek in The Oaks. At least five trees occur on the Nattai River in Nattai National Park. Large areas of habitat were inundated by the formation of Warragamba Dam in 1933.	BAM-C	Low – preferred habitat not recorded in the study area. Outside of known distribution.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Eucalyptus camfieldii</i> (Heart-leaved Stringybark)	V	V	No	Occurs in scattered locations within a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Grows in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone, in coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas (Office of Environment & Heritage 2018). Associated species frequently include Brown Stringybark (<i>E. capitellata</i>), Scribbly Gum (<i>E. haemastoma</i>), Narrow-leaved Stringybark (<i>E. oblonga</i>), Silvertop Ash (<i>E. sieberi</i>), Smooth-barked Apple (<i>Angophora costata</i>), Dwarf Apple (<i>A. hispida</i>), Red Bloodwood (<i>Corymbia gummifera</i>), Scrub She-oak (<i>Allocasuarina distyla</i>), Slender Tea Tree (<i>Leptospermum trinervium</i>), and Fern-leaved Banksia (<i>Banksia oblongifolia</i>) (Leigh, Boden et al. 1984, Benson and McDougall 1998). Department of Environment and Climate Change 2008).	PlantNet, BioNet	Low - This species is known to occur within coastal heath and low open woodland on exposed sandy ridges of which no similar habitats were recorded within the study area. There are no records within the locality.	No
<i>Eucalyptus nicholii</i> (Narrow-leaved Black Peppermint)	V	V	No	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.	BioNet	Low - Few records within the locality. No preferred habitat within the study area.	No
<i>Eucalyptus scoparia</i>	E1	V	Yes	Occurs in Queensland and reaches its southern limit in NSW. In NSW it is known from three locations all near Tenterfield in the far northern New England Tableland Bioregion where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	BioNet	Low - Few records within the locality, possibly as street plantings. No preferred habitat within the study area.	No
<i>Genoplesium baueri</i> (Yellow Gnat-orchid, Bauer's Midge Orchid)	E1	E	Yes	Grows in dry sclerophyll forest and moss gardens over sandstone. 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 northern Sydney suburbs. 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 (Office of Environment and Heritage 2014)	PMST	Low – this species has not recorded in the locality and no associated PCTs or preferred habitat was recorded within the study area.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Grevillea beadleana</i> (Beadle's Grevillea)	E	E	No	Known from four separate areas, all in north-east NSW: the Torrington area west of Tenterfield, Oxley Wild Rivers National Park, Guy Fawkes River National Park and at Shannon Creek south-west of Grafton. Historical records suggest it was also once found near Walcha. Open eucalypt forest with a shrubby understorey. It is usually found on steep granite slopes at high altitudes, although the population at Shannon Creek is at a lower elevation on sandstone.	BAM-C	Low – No preferred habitat found within the study area.	No
<i>Grevillea juniperina</i> subsp. <i>juniperina</i> (Juniper-leaved Grevillea)	V	-	No	Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest. Endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town.	BAM-C	Moderate – Study area is outside of species known distribution. Not previously recorded within locality. Included as a candidate species based on the presence of PCT 725. Not recorded during targeted surveys.	No - surveyed
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> (Small-flower Grevillea)	V	V	No	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct population near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Department of Planning Industry and Environment, 2020).	Bionet, PMST, PlantNet	Moderate - Potential habitat within the study area. Records within the locality, at Lieutenant Cantello Reserve. Not recorded during targeted surveys.	No -surveyed
<i>Gyostemon thesioides</i>	E	-	Yes	Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. The most recent sighting was of a single male plant near the Colo River within Wollemi National Park. The species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively, despite searches. Grows on hillsides and riverbanks and may be restricted to fine sandy soils. A fire-opportunist, with recruitment occurring from a soil stored seed bank following fire. Adult plants are killed by fire. Plants reach maturity in less than a year and plants are presumably short-lived.	BAM-C	Low – Possible habitat on site however has not been recorded from within the locality for 30 years despite searched. Closets recorded is near Heathcote Road in 1967.	No
<i>Haloragis exalata</i> subsp. <i>exalata</i> (Square Raspwort)	V	V	No	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Square Raspwort appears to require protected and shaded damp situations in riparian habitats.	BAM-C	Low – Low quality habitat on site. Has not been recoded within locality with the closest record in 1892 recorded at Coalcliff.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Hibbertia fumana</i>	CE	-	Yes	Currently only known from a single population at Moorebank but potentially elsewhere in greater Sydney. Generally found in areas of woodland with a more open understorey, in a long intergrade between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest at the Moorebank Site (Office of Environment & Heritage 2018).	BioNet, PlantNet	<p>Low - <i>Hibbertia fumana</i> has recently been identified within the Bankstown Airport site adjoining the study area (pers. com. Andrew Orme RBG). Candidate species subject to targeted survey during flowering period.</p> <p>Detailed targeted surveys were conducted for this species during the known flowering period. A single species of <i>Hibbertia</i> was recorded to occur within Stage 1A of the study area. Parallel traverse identified a population extent of 5 individuals within a patch of PCT 725 vegetation. Fertile flowering material was collected from these individuals and forwarded to the National Herbarium of NSW for positive identification. The species was identified to be the non-threatened <i>Hibbertia pedunculata</i> based on the stamen arrangement around the carpel and the length of the flowering peduncle (pers. com. Andrew Orme, National Herbarium of NSW). No specimens of this species were recorded during targeted surveys and based on completed detailed field surveys it is reconsidered to have a low likelihood of occurrence within the study area.</p>	No - surveyed

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Hibbertia puberula</i>	E	-	No	Recent work on this species (Toelken and Miller 2012) and its relatives have shown it to be widespread, but never common. It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. It favours low heath on sandy soils or rarely in clay, with or without rocks (Toelken and Miller 2012) (Office of Environment and Heritage 2014).	BioNet, PlantNet	Low – see discussion for <i>Hibbertia fumana</i>	No - surveyed
<i>Hibbertia sp. Bankstown</i> (<i>Hibbertia puberula</i> subsp. <i>Glabrescens</i>)	CE	CE	Yes	Endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown local government area. The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. The species is not known from any conservation reserves. The population comprises fewer than 50 individuals (Office of Environment & Heritage 2018).	BioNet, PMST, PlantNet	Low – see discussion for <i>Hibbertia fumana</i>	No - surveyed
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	E	-	No	Known from two populations, one in southern Sydney on both sides of the Woronora River gorge (near Loftus and in Royal National Park and one near Nowra. Habitat of the Sydney population is dry eucalypt forest and woodland; mainly on upper slopes at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone (Office of Environment & Heritage 2016). It usually grows in 'gravelly loam or clay soil in heath under open woodland' (Toelken and Miller 2012).Habitat on the South Coast is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone(Office of Environment & Heritage 2018).	PlantNet	Low – see discussion for <i>Hibbertia fumana</i>	No
<i>Leucopogon exolasius</i> (<i>Woronora Beard-heath</i>)	V	V	No	Restricted chiefly to the Woronora and Grose Rivers and Stokes Creek, Sydney catchments and the Royal National Park. One old record from the Grose River. Grows in woodland on sandstone (Royal Botanic Gardens 2004).	BioNet, PMST, PlantNet	Low - Few records within the locality, outside known distribution, preferred habitat does not occur.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> (Native Pear)	E2	-	No	Occurs in subcoastal and southern Queensland but rarely in NSW with a disjunct occurrence near Sydney. It occurs as scattered plants in remnant woodland and scrub (NSW Scientific Committee 2000, Harden 2002). <i>Marsdenia viridiflora</i> R. Br. subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	BioNet	Moderate - Known populations occur in the locality. Not recorded during targeted surveys.	No - surveyed
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	V	V	No	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 Department of Planning Industry and Environment, 2020).	PMST, PlantNet, BioNet	Low - Outside known distribution. No preferred habitat within the study area.	No
<i>Melaleuca deanei</i> (Deanes Paperbark)	V	V	Yes	Occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone (Office of Environment & Heritage 2018).	PMST, PlantNet	Low - No preferred habitat within the study area.	No
<i>Micromyrtus minutiflora</i>	E	V	Yes	Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments. Sporadic flowering, June to March. Response to fire and mechanical disturbance is uncertain. Regeneration may be due to resprouting or germination of soil-stored seed.	BAM-C	Low – Study area is outside of species known distribution. Not previously recorded within locality.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Pelargonium</i> sp. <i>Striatellum</i> (G. W. Carr 10345), syn. <i>Pelargonium</i> sp., <i>Pelargonium</i> sp. 1 (Omeo Stork's-bill)	E1	E	Yes	Known from only 4 locations in NSW, with three on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. It occurs with Serrated Tussock (<i>Nassella trichotoma</i>) and Curly Sedge (<i>Carex bichenoviana</i>), and less commonly with Creeping Hopbush (<i>Dodonaea procumbens</i>) and a bog-sedge (<i>Schoenus nitens</i>) on sandy soils or gravelly soils or amongst rocks.	PMST	Low - No records within the locality. Preferred habitat does not occur within the study area.	No
<i>Persicaria elatior</i> (Tall Knotweed)	V	V	No	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 (Office of Environment & Heritage 2018).	PMST	Low – Though low quality habitat was recorded; study area is outside of species known distribution. Previously recorded in Picton in 1949	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Persoonia bargoensis</i> (Bargo Geebung)	E	V	No	The Bargo Geebung is restricted to a small area south-west of Sydney on the western edge of the Woronora Plateau and the northern edge of the Southern Highlands. The historical limits are Picton and Douglas Park (northern), Yanderra (southern), Cataract River (eastern) and Thirlmere (western). The Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils of the Wianamatta Shale and Hawkesbury Sandstone. It favours interface soil landscapes such as between the Blacktown Soil Landscape and the complex Mittagong Formation soils (Lucas Heights Soil Landscape) with the underlying sandstone (Hawkesbury Soil Landscape and Gynea Soil Landscape). Some of the vegetation the species occurs within would be recognised as the Shale/Sandstone Transition Forest, a listed community.	BAM-C	Low – Associated habitat not present within study area. Not previously recorded within locality.	No
<i>Persoonia hirsuta</i> (Hairy Geebung)	E1	E	Yes	The species occurs in small populations distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains in the west. It is found in dry sclerophyll open forest, woodland and heath on sandstone, growing in sandy soils (Department of Planning Industry and Environment, 2020).	BioNet, PMST	Low - Few records within the locality. No preferred habitat within the study area.	No
<i>Persoonia nutans</i> (Nodding Geebung)	E1	E	No	Confined to the Cumberland Plain where it grows in Castlereagh Scribbly Gum Woodlands and Agnes Banks Woodlands (James 1997, NSW National Parks and Wildlife Service 2001, Harden 2002).	Bionet, PMST, PlantNet	Low - Few records within the locality. No preferred habitat within the study area.	No
<i>Pilularia novae-hollandiae</i> (Austral Pillwort)	E	-	Yes	Austral Pillwort is a semi-aquatic fern, resembling a small fine grass. Its thread-like fronds, to 8 cm long, arise in tufts from a creeping underground stem (rhizome). The fruiting capsules are small, spherical hairy pills that form at the base of fronds. In NSW, Austral Pillwort has been recorded from suburban Sydney, Khancoban, the Riverina between Albury and Urana (including Henty, Walbundrie, Balldale and Howlong), Oolambeyan National Park near Carathool and at Lake Cowal near West Wyalong.	BAM-C	Low – Preferred habitat shallow swamps and waterways limited on site. Not recorded within locality with nearest record near Doonside in 1966.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	No	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 (James 1997, NSW Scientific Committee 1998, James, McDougall et al. 1999, Harden 2000).	PMST	Low – Preferred habitat not recorded within the study area. No records within the locality.	No
<i>Pimelea spicata</i> (Spiked Rice-flower)	E1	E	No	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 <i>Bursaria spinosa</i> and <i>Themeda australis</i> . In the Illawarra, it occurs on well structured clay soils in grassland or open woodland (James 1997, Harden 2000, NSW National Parks and Wildlife Service 2000).	BioNet, PMST, PlantNet	Moderate - Species is known to occur within Stage 3 study area (GHD, 2014). This species is considered further within the body of the report. Not recorded within the study area despite targeted surveys	No - surveyed
<i>Pomaderris brunnea</i>	E1	V	No	Confined to the Colo and Upper Nepean Rivers where it grows in open forest (Harden 2000); in western Sydney (Camden to Picton area) known from sandy alluvium on levee and creek banks (James 1997).	BioNet, PlantNet, BAM - C	Moderate - Outside known distribution. No records within the locality. Included as a candidate species based on the presence of PCT 835 and PCT 1800. Not recorded during targeted surveys.	No -surveyed
<i>Pomaderris prunifolia</i> (Plum-leaf Pomaderris)	E2	-	No	Occurs on rocky slopes, often along creeks (Harden 2000). The population in Paramatta, Auburn, Strathfield and Bankstown LGAs is listed as Endangered under the BC Act. Within the Endangered population, the only recent record of this species is from Rydalmere, where only 3 plants occur.	BioNet, BAM-C	Low - Records within the locality at The Crest reserve. Few records within the locality. No preferred habitat within the study area.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Prostanthera saxicola</i>	E2	-	No	This population is restricted to the named local government areas (Liverpool and Sutherland). Recorded occurrences are mainly between Holsworthy station and Sutherland station, north from Lucas Heights and south of the Georges River. Habitat includes: Eucalypt forest and heath in association with <i>Hakea dactyloides</i> , <i>Brachyloma daphnoides</i> , <i>Banksia spinulosa</i> , <i>Baeckea brevifolia</i> , <i>Epacris pulchella</i> , <i>Acacia myrtifolia</i> and <i>Acacia ulicifolia</i> ; Closed heath in association with <i>Allocasuarina nana</i> and <i>Lepidosperma viscidum</i> . Heathy woodland of <i>Angophora hispida</i> , <i>Eucalyptus squamosa</i> and <i>Corymbia gummifera</i> , as a 'major component of the ground flora'; and rocky ridges and areas of outcrop.	BioNet	Low – Not previously recorded within locality, limited suitable habitat within study area.	No
<i>Pterostylis gibbosa</i>	E1	E	No	Occurs in the southern part of the Central Coast region with a disjunct population in the Hunter Valley. Grows among grass in sclerophyll forest (Harden 2002). In the Illawarra it grows in Coastal Grassy Red Gum Forest and in Lowland Woollybutt-Melaleuca forest (NSW National Parks and Wildlife Service 2003).	PMST	Low - Preferred habitat is not recorded within the study area. No records within the locality.	No
<i>Pterostylis saxicola</i> (Sydney Plains Greenhood)	E1	E	No	Known now only from Freemans Reach to Picton district. Grows in Sydney Sandstone Gully Forest in shallow or skeletal soils over sandstone shelves, often near streams (Harden 1993, James 1997, Department of Environment and Climate Change 2007)	BioNet, PMST, PlantNet	Low – Preferred habitat is not recorded within the study area. No records within the locality.	No
<i>Pultenaea aristata</i>	V	V	No	Occurs from Helensburgh to Mt Keira where it grows in moist, dry sclerophyll woodland to heath on sandstone. Also grows within upland swamps on the Illawarra Plateau (pers obs).	BioNet	Low - Outside known distribution.	No
<i>Pultenaea parviflora</i>	E1	V	No	Restricted to the Cumberland Plain where it grows in dry sclerophyll forest on Wianamatta shale, laterite or alluvium (Harden 2002). Locally abundant within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. Also occurs in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland (James 1997, NSW National Parks and Wildlife Service 2002).	BioNet	Moderate - Preferred habitat within the study area, however few records within the locality. Not recorded during targeted surveys.	No - surveyed

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Pultenaea pedunculata</i> (Matted Bush-Pea)	E1	-	No	Restricted to Wianamatta Shales of the Cumberland Plain from Bankstown to Liverpool and on the South Coast in the Southeast Corner Bioregion at Bournda. If grows on a variety of soils in dry sclerophyll forest and disturbed sites (NSW Scientific Committee 1999, Harden 2000, NSW National Parks and Wildlife Service 2002). It is largely confined to loamy soils in dry gullies in populations in the Windellama area (Department of Environment and Climate Change 2008).	BioNet, PlantNet	Moderate - Preferred habitat within the study area. Existing records within locality. Not recorded during targeted surveys.	No - surveyed
<i>Rhizanthella slateri</i> (Eastern Underground Orchid)	V	E	Yes	The eastern underground orchid is endemic to New South Wales where it occurs from the mid-north coast to the south coast (TSSC, 2007). It is reported as occurring in south-east Queensland (e.g. ALA, 2013; OEH, 2013a), however it is not included in Queensland's flora census (Queensland Herbarium, 2013) and another report indicates that the Great Lakes local government area is the northern limit of the species range (OEH, 2013b). The eastern underground orchid is known from 14 populations (NSW OEH, 2013b) with records from Bulahdelah (Bulahdelah State Forest, within the Great Lakes LGA endangered population), the Watagan Mountains, the Blue Mountains, Agnes Banks, Wiseman's Ferry (Dharug National Park) and near Nowra (NSW SC, 2002; NSW NPWS 2007). The species is known from sclerophyll forest usually with a deep layer of organic litter (OEH, 2013b).	EPBC PMST	Low – no preferred habitat found within the study area.	No.
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	CE	-	Yes	Currently known to occur from coastal districts north from Batemans Bay, approximately 280 km south of Sydney, to the Queensland (Qld) border. Populations of the species extend north to Maryborough, Qld. NSW populations of <i>R. rubescens</i> are mainly coastal and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000–1,600 mm. Populations and individuals of <i>R. rubescens</i> are often found in wet sclerophyll associations in rainforest transition zones and creekside riparian vegetation (Department of Planning Industry and Environment, 2021).	PlantNet BioNet	Low – No preferred habitat within study area.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Rhodomyrtus psidioides</i> (Native Guava)	CE	CE	Yes	A shrub or small tree to 12 m high with brown scaly bark. 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. (Department of Planning Industry and Environment, 2020).	PMST	Low – No preferred habitat within study area.	No
<i>Syzygium paniculatum</i> (Magenta Lilly Pilly)	E	V	No	Occurs between Bulahdelah 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 Department of Planning Industry and Environment, 2020).	BioNet PMST	Low - Preferred habitat is not recorded within the study area.	No
<i>Tetratheca glandulosa</i>	V	-	No	Restricted to the following Local Government Areas: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. There are approximately 150 populations of this plant ranging from Sampons Pass (Yengo NP) in the north to West Pymble (Lane Cove NP) in the south. The eastern limit is at Ingleside (Pittwater LGA) and the western limit is at East Kurrajong (Wollemi NP). There are historical collections of this species south to Manly, Willoughby and Mosman, however these populations are now extinct. The current north-south range is approximately 65km.	PlantNet	Low – Preferred habitat is not recorded within the study area.	No
<i>Thelymitra kangaloonica</i>	-	CE	Yes	It is found in swamps in sedgelands over grey silty grey loam soils. Only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at three swamps that are above the Kangaloon Aquifer (Office of Environment and Heritage 2015).	PMST	Low - Preferred habitat is not recorded within the study area. No records within the locality.	No

Common Name (Scientific Name)	BC Act ¹	EPBC Act ²	SAII ³	Habitat requirements	Number of records (Source)	Likelihood of occurrence	Significant impact assessment required?
<i>Thesium australe</i> (Austral toadflax)	V	V	No	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Grows in association with <i>Themeda triandra</i> and (less frequently) with <i>Poa</i> spp. Department of Planning Industry and Environment, 2020).	PMST BAM-C	Moderate - The species has no records within the locality. Included as a candidate species based on the presence of PCT 835. Not recorded during targeted surveys.	No - surveyed
<i>Wahlenbergia multicaulis</i> (Tadgells Bluebell)	E2	-	No	Occurs in coastal and tableland districts south from Sydney and the Blue Mountains west along the Murray River to Mathoura where it grows in a variety of habitats including forest, woodland, grassland (Harden 1992), forest, scrub and the edges of watercourses and wetlands. It is a coloniser and typically occurs in damp, disturbed sites (NSW Scientific Committee 2003). Population in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas listed as Endangered under the BC Act.	BioNet BAM-C	Moderate - Possible habitat within the study area and there are also species records nearby the intersection of the M7 motorway. Not recorded during targeted surveys.	No – surveyed
<i>Wilsonia backhousei</i> (Narrow-leafed Wilsonia)	V	-	No	Occurs chiefly in the Sydney district but also common at Jervis Bay (Harden 2000). A salt tolerant species, it is found in intertidal saltmarshes and sometimes on seacliffs (NSW Scientific Committee 2000).	BioNet, PlantNet BAM-C	Moderate - The study area is outside the species known distribution range. Included as a candidate species based on the presence of PCT 920 and PCT 1234. Not recorded during targeted surveys.	No – surveyed
<i>Zannichellia palustris</i>	E	-	No	In NSW, known from the lower Hunter and in Sydney Olympic Park. Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months.	BAM-C	Low – Preferred habitat not recorded within the study area. Not previously recorded within locality.	No

- (1) Listed under the NSW Biodiversity Conservation Act 2016 – E4 = Presumed extinct, CE = Critically Endangered, E1 = Endangered Species, E2 = Endangered Population, V = Vulnerable
- (2) SAII = Serious and Irreversible Impact entity under BAM
- (3) Listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 – X = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory
- (4) Bionet = OEH Bionet Atlas of NSW Wildlife, PMST = EPBC Act Protected Matters Search Tool, PlantNet = Royal Botanic Gardens PlantNet Spatial Search and BAM-C = Biodiversity Assessment Method Calculator output.

B2 – Habitat assessment table – threatened fauna species

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Amphibians								
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	V	V	No	Species credit	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Breeding habitat of this species is generally soaks or pools within first or second order streams. Species is dependent on hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features in the Sydney Basin.	PMST	Low - confined to sandstone ridgetop habitat and upland valleys where it is associated with small headwater and slow flowing/intermittent creek lines. Such habitat does not occur in the study area. This species has not been recorded within the locality.	No
Green and Golden Bell Frog (<i>Litoria aurea</i>)	E1	V	No	Species credit	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available.	BAM-C, BioNet, PMST	Low - Potential marginal habitat within the study area. Possible utilisation by the frogs, however there has been little records within the locality in the last 30 years. Detailed targeted surveys did not record this species.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Littlejohn's Tree Frog (<i>Litoria littlejohni</i>)	V	V	No	Species credit	Has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. The majority of records are from within the Sydney Basin Bioregion with only scattered records south to the Victorian border and this species has not been recorded in southern NSW within the last decade. Records are isolated and tend to be at high altitude. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	PMST	Low - Breeding habitat is associated with upper reaches of permanent rocky streams with fringing vegetation and perched swamps. Foraging habitat includes shrub and groundcover within 100 m of breeding habitat. The study area does not constitute breeding or foraging habitat and this species is considered to have a low likelihood of occurrence. This species has not been recorded within the locality.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Red-crowned Toadlet (<i>Pseudophryne australis</i>)	V	-	No	Species credit	The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5. Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites.	BioNet	Low - localised species that is largely restricted to the immediate vicinity of ephemeral creeks and gutters below sandstone ridges. Such habitat does not occur in the study area.	No
Southern Bell Frog (<i>Litoria raniformis</i>)	E1	V	No	Species credit	In NSW the species was once distributed along the Murray and Murrumbidgee Rivers and their tributaries, the southern slopes of the Monaro district and the central southern tablelands as far north as Tarana, near Bathurst. Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. A few yet unconfirmed records have also been made in the Murray Irrigation Area in recent years. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	PMST	Low - The known habitat of this species is not present within the study area. The study area is outside the known distribution for this species, and it has not been recorded within the locality.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Stuttering Frog (<i>Mixophyes balbus</i>)	E1	V	Yes	Species credit	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 <i>Mixophyes</i> 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. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	PMST	Low - occupies streams in rainforest or tall open wet forest in foothills and escarpment on the eastern side of the Great Dividing Range. Such habitat does not occur in the study area. This species has not been recorded within the locality.	No
Birds								
Australasian Bittern (<i>Botaurus poiciloptilus</i>)	E1	E	No	Ecosystem credit	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.). Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds.	BAM-C, BioNet, PMST	Low - a wetland bird that frequents freshwater and brackish swamps, in which it forages and breeds. Marginal habitat occurs within the vicinity of the study area; majority of artificial wetlands lack dense aquatic vegetation which is preferred by the species. Closest records at Deepwater Park.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Australian Painted Snipe (<i>Rostratula australis</i>)	E1	E; Ma	No	Ecosystem credit	The Australian Painted Snipe is restricted to Australia. Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	BAM-C, PMST	Low – a wetland bird that prefers marshes where bank side vegetation provides cover. Artificial wetlands lack sufficient aquatic vegetation that is preferred by the species. No records within the locality.	No
Barking Owl (Ninox connivens)	V	-	No	Ecosystem credit / Species credit: hollow-bearing trees that provide active nesting habitat Ecosystem credit: all 'other habitat'	The Barking Owl is found throughout continental Australia except for the central arid regions. Although common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. Many populations crashed as woodland on fertile soils was cleared over the past century, leaving linear riparian strips of remnant trees as the last inhabitable areas. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. 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. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils.	BAM-C	Low – prefers drier intact woodlands and forests compared to other owl species. Intermittent occurrences within the study may occur, however, more known to occur in woodlands to the west of the divide.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Bar-tailed Godwit (<i>Limosa lapponica baueri</i>)	-	V; M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	The Bar-tailed Godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (western Alaskan) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats.	PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of large intertidal mudflats not within the study area. No records within the locality.	No
Black Bittern (<i>Ixobrychus flavicollis</i>)	V	-	No	Ecosystem credit	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds.	BAM-C BioNet	Low - uses the lower reaches of coastal creeks and rivers within rainforest habitat. There is marginal habitat within the study area (associated with artificial wetlands) and intermittent occurrences within the study area cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Black-chinned Honeyeater (<i>Melithreptus gularis gularis</i>)	V	-	No	Ecosystem credit	The eastern subspecies extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	BAM-C, BioNet	Low - The Black-chinned Honeyeater is a western woodlands species that only rarely occurs in near coastal locations. Closest record along the Georges River at Liverpool. Rare or intermittent occurrences cannot be discounted.	No
Black-faced Monarch (<i>Monarcha melanopsis</i>)	-	M; Ma	No	-	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating.	PMST	Low – preferred habitat not within study area. Rare and intermittent occurrences cannot be discounted.	No
Black Falcon (<i>Falco subniger</i>)	V	-	No	Ecosystem credit	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	BAM-C	Low – species has a wide range and are often highly mobile. Intermittent occurrences cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Black-necked Stork (<i>Ephippiorhynchus asiaticus</i>)	E1	-	No	Ecosystem credit	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Inhabits floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	BAM-C, BioNet	Low - forages in freshwater and estuarine wetlands and lakes. They breed in floodplain habitats in northern Australia south to the northern Hunter Region. Suitable breeding habitats do not occur within the study area. Marginal foraging habitat occurs within the vicinity of the study area, rare seasonal occurrences cannot be dismissed. Closest records at Deepwater Park.	No
Black-tailed Godwit (<i>Limosa limosa</i>)	V	M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. The species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state. Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	BAM-C, PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of large intertidal mudflats not within the study area. No records within the locality.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Broad-billed Sandpiper (<i>Limicola falcinellus</i>)	V	M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW. Favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	BAM-C	Low – marginal habitat near mangroves along Georges River. Preferred habitat of intertidal mudflats limited within the study area. Rare occurrences during seasonal movements cannot be discounted. No records within the locality.	No
Brown Treecreeper (<i>Climacteris picumnus victoriae</i>)	V	-	No	Ecosystem credit	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>), forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding.	BAM-C	Low – prefers intact woodlands and forest of inland slopes and plains. Important habitat components limited. Rare occurrences within intact woodland may occur.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Bush-stone Curlew (<i>Burhinus grallarius</i>)	E1	-	No	Species credit: fallen/standing dead timber including logs required	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	BAM-C; BioNet	Low - This species is unlikely to occur within the locality, thought to be extinct from the locality.	No
Cattle Egret (<i>Ardea (Bulbulcus) ibis</i>)	-	M	N/A	Not listed on the BC Act	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands and very rarely in arid and semi-arid regions. High numbers may occur in moist, poorly drained pastures with high grass; it avoids low grass pastures but has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. It is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora.	PMST	Low – Intermittent use of artificial wetland areas may occur during seasonal movements.	No
Comb-crested Jacana (<i>Irediparra gallinacea</i>)	V	-	No	Ecosystem credit	The Comb-crested Jacana occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW, with stragglers recorded in south-eastern. Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation.	BAM-C	Low – preferred habitat of large amounts of floating aquatic vegetation within artificial wetlands not present	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Common Greenshank (<i>Tringa nebularia</i>)	-	M; Ma	N/A	Not listed on the BC Act	Occurs in a range of inland and coastal environments. Inland, it occurs in both permanent and temporary wetlands, billabongs, swamps, lakes floodplains, sewage farms, saltworks ponds, flooded irrigated crops. On the coast, it occurs in sheltered estuaries and bays with extensive mudflats, mangrove swamps, muddy shallows of harbours and lagoons, occasionally rocky tidal ledges. It generally prefers wet and flooded mud and clay rather than sand.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or swamps. Rare and intermittent occurrences during seasonal movements cannot be discounted.	No
Common Sandpiper (<i>Actitis hypoleucos</i>)	-	M, Ma	N/A	Not listed on the BC Act	The Common Sandpiper frequents a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. It is mostly encountered along muddy margins or rocky shores and rarely on mudflats. It has been recorded in estuaries and deltas of streams, banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or floodplains. Rare and intermittent occurrences during seasonal movements cannot be discounted.	No
Curlew Sandpiper (<i>Calidris ferruginea</i>)	E1	CE, M, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	BAM-C, PMST	Low - This species is unlikely to occur within the locality. However, there is marginal habitat available in the vicinity of the study area, and accidental or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Diamond Firetail (<i>Stagonopleura guttate</i>)	V	-	No	Ecosystem credit	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	BAM-C	Low – marginal habitat within study area, uncommon in coastal areas. Rare occurrences within the locality cannot be discounted.	No
Dusky Woodswallow (<i>Artamus cyanopterus cyanopterus</i>)	V	-	No	Ecosystem credit	Dusky woodswallows are widespread in eastern, southern and south-western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.	BAM-C, BioNet	Moderate - potential foraging habitat available. This species has been recorded within the locality.	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Eastern Bristlebird (<i>Dasyornis brachypterus</i>)	E	E	No	Species credit	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species.	PMST	Low - No preferred habitat within the study area. No records within the locality.	No
Eastern Curlew (<i>Numenius madagascariensis</i>)	-	CE, M, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Inhabits coastal estuaries, mangroves, mud flats and sand pits. It is a migratory shorebird which generally inhabits sea and lake shore mudflats, deltas and similar areas, where it forages for crabs and other crustaceans, clam worms and other annelids, molluscs, insects and other invertebrates. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in northern China, Korea and Russia.	PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of intertidal mudflats limited within the study area. Rare occurrences during seasonal movements cannot be discounted. No records within the locality.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Eastern Osprey (<i>Pandion cristatus</i>)	V	-	No	Ecosystem credit / Species credit Species credit: presence of active stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting Ecosystem credit: all 'other habitat'	Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	BAM-C, BioNet, PMST	Moderate - The species is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. There is potential for the species to forage along the Georges River.	Yes
Flame Robin (<i>Petroica phoenicea</i>)	V	-	No	Ecosystem credit	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	BAM-C, BioNet	Low - breeds in elevated woodland habitats of the Great Dividing Range and its foothills. They also disperse from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds. Marginal habitat available. Closest record at Voyager Point.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Fork-tailed Swift (<i>Apus pacificus</i>)	-	M; Ma	No	-	Breeds in the northern hemisphere, wintering south to Australia. It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. It mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. It also occurs over towns and cities. It mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. It sometimes occurs above forests. It probably roosts aerially, but has occasionally been observed to land	PMST	Low - May occur over the study area intermittently during seasonal migration movements but unlikely to use terrestrial habitats.	No
Freckled Duck (<i>Stictonetta naevosa</i>)	V	-	No	Ecosystem credit	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other 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.	BAM-C	Low – prefers large swamps often with dense aquatic vegetation. Limited available habitat in study area.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V	-	No	Ecosystem credit / Species credit Species: presence of Eucalypt tree species with hollows greater than 9 cm diameter actively being used Ecosystem credit: all 'other habitat'	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (<i>Eucalyptus pauciflora</i>) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	BAM-C, BioNet	Low – Preferred habitat of mature/old growth eucalypt forest not within study. Intermittent and rare seasonal occurrences during seasonal movements cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Glossy Black- cockatoo (<i>Calyptorhynchus lathamii</i>)	V	-	No	Ecosystem credit / Species credit Species: presence of living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground actively being used Ecosystem credit: all 'other habitat'	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak (<i>Allocasuarina diminuta</i>). Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (<i>Casuarina cristata</i>). Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	BioNet	Low - Potential foraging habitat available in study area (presence of <i>Allocasurina</i> sp.). Several records within locality but no individuals recorded since 2014. Any individual that visits the locality is most likely a vagrant.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Great Egret (<i>Ardea alba</i> (syn. <i>Ardea modesta</i>))	-	Ma	No	-	Eastern Great Egrets are widespread in Australia. They occur in all states/territories of mainland Australia and in Tasmania. In Australia, the largest breeding colonies, and greatest concentrations of breeding colonies, are located in near-coastal regions of the Top End of the Northern Territory. The Channel Country of south-western Queensland and north-eastern South Australia have at least 12 breeding colonies, and colonies are also known in the Darling Riverine Plains region of NSW and the Riverina region of NSW and Victoria. Minor breeding sites are widely scattered across the species' distribution and include sites in western Cape York Peninsula, the central coast of Queensland, north and north-eastern NSW, south-eastern South Australia, south-western Western Australia, the Kimberley region of Western Australia and the Barkly Tablelands in the Northern Territory. Non-breeding birds have been recorded across much of Australia, but avoid the driest regions of the western and central deserts. The Eastern Great Egret inhabits a wide range of wetland habitats which include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs.	PMST	Low – Intermittent use of artificial wetland areas may occur during seasonal movements.	No
Grey Falcon (<i>Falco hypoleucos</i>)	E	V	No	Ecosystem credit	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.	PMST	Low – rarely found on the coast.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Hooded Robin (<i>Melanodryas cucullata cucullata</i>)	V	-	No	Ecosystem credit	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form (subspecies <i>cucullata</i>) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies <i>picata</i> . Two other subspecies occur outside NSW. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	BAM-C	Low – rarely found on the coast. Preferred habitat not within study area.	No
Latham's Snipe (<i>Gallinago hardwickii</i>)	-	M, Ma	No	-	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	PMST	Low – wetlands and artificial wetlands provide marginal habitat. Prefers wetlands with abundant aquatic vegetation for protection, this is limited within study area.	No
Little Eagle (<i>Hieraaetus morphnoides</i>)	V	-	No	Ecosystem credit / Species credit Species: presence of nest trees - live (occasionally dead) large old trees within vegetation actively being used Ecosystem credit: all 'other habitat'	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.	BAM-C, BioNet	Low – marginal foraging habitat available in the vicinity of the study area. No nests found during the survey. Intermittent or rare occurrences under suitable conditions cannot be entirely discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	No	Ecosystem credit	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards.	BAM-C, BioNet	Moderate - Potential foraging habitat in study area associated with blossoming eucalypts. Recorded within the locality.	Yes
Masked Owl (<i>Tyto novaehollandiae</i>)	V	-	No	Ecosystem credit / Species credit Species: presence of living or dead trees with hollows greater than 20cm diameter actively being used Ecosystem credit: all 'other habitat'	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares.	BAM-C BioNet	Low –Records within the locality and to the south in larger intact remnants. May intermittently forage within study as part of a larger home range. However, habitat within the subject site is degraded to the point that the species is unlikely to use the subject land.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Northern Siberian Bar-tailed Godwit (<i>Limosa lapponica menzbieri</i>)	-	CE	No	-	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (northern Siberian) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats.	PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of intertidal mudflats limited within the study area. Rare occurrences during seasonal movements cannot be discounted. No records within the locality.	No
Orange-bellied Parrot (<i>Neophema chrysogaster</i>)	CE	CE, Ma	Yes	Species credit	The 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. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. It is expected that NSW habitats may be being more frequently utilised than observations suggest. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured but they will turn up anywhere within these coastal regions. The species can be found foraging in weedy areas associated with these coastal habitats or even in totally modified landscapes such as pastures, seed crops and golf courses.	PMST	Low - Considered locally extinct. No preferred habitat within the study area. No records within the locality.	No
Oriental Cuckoo (<i>Cuculus opatus</i> (syn. <i>Cuculus saturatus</i>))	-	M, Ma	No	-	A non-breeding migrant to Australia, it often inhabits rainforest, vine thickets, wet sclerophyll forest and open woodland and sometimes occurs in mangroves, wooded swamps and as vagrants in gardens. The population trend appears to be stable.	PMST	Low – preferred habitat not within study area. Rare and intermittent occurrences cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Painted Honeyeater (<i>Grantiella picta</i>)	V	V	No	Ecosystem credit	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree/ Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	BAM-C, PMST	Low - No preferred habitat within the study area. No records within the locality.	No
Pectoral Sandpiper (<i>Calidris melanotos</i>)	-	M, Ma	No	-	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is usually found in coastal or near coastal habitat but occasionally further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or floodplains. Rare and intermittent occurrences during seasonal movements cannot be discounted.	No
Pink Robin (<i>Petroica rodinogaster</i>)	V	-	No	Species credit	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	BioNet	Low - Very marginal habitat, on the edge of range. Irregular occurrences cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Powerful Owl (<i>Ninox strenua</i>)	V	-	No	Ecosystem credit / Species credit Species: presence of living or dead trees with hollows greater than 20cm diameter actively being used Ecosystem credit: all 'other habitat'	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations. It inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angophora floribunda</i> , Cherry Ballart <i>Exocarpus cupressiformis</i> and a number of eucalypt species. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider.	BAM-C, BioNet	Low - There are records within the locality, the closets record is at Deepwater Park. No large hollow bearing trees within study area and habitat is degraded to the point that the species is unlikely to use the subject land.	No
Rainbow Bee-eater (<i>Merops ornatus</i>)	-	Ma	No	-	Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings.	PMST	Low – prefer habitat limited within study area. Irregular and intermittent occurrences during seasonal movements cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Red Knot (<i>Calidris canutus</i>)	-	E, M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	PMST	Low - This species is unlikely to occur within the locality. However, there is marginal habitat available in the vicinity of the study area, and accidental or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	No
Regent Honeyeater (<i>Anthochaera phrygia</i>)	CE	CE	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. It inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. It feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany.	BAM-C, BioNet, PMST	Low - Marginal foraging habitat available. Rare occurrences under suitable seasonal conditions cannot be discounted. The last record within the locality is over 25 years old.	No
Rufous Fantail (<i>Rhipidura rufifrons</i>)	-	M, Ma	No	-	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.	PMST	Low – no preferred habitat within study area. Rare occurrences during migration cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	-	M, Ma	No	-	Widespread in eastern Australia. In Queensland, it is widespread but scattered in the east. In NSW, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. In Victoria, the species is widespread in the south and east, in the area south of a line joining Numurkah, Maldon, the northern Grampians, Balmoral and Nelson. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests, often occurring in gullies. They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest. In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the treeline.	PMST	Low – preferred habitat within study area limited. Rare and intermittent occurrences cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Scarlet Robin (<i>Petroica boodang</i>)	V	-	No	Ecosystem credit	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. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude.	BAM-C, BioNet	Low - The Scarlet Robin breeds in elevated woodland habitats of the Great Dividing Range and its foothills. They disperse from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds. Marginal habitat available. Closest record at Voyager Point.	No
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	-	M, Ma	No	-	Occurs in a variety of habitats: tidal mudflat, mangrove swamps, saltmarshes, shallow fresh, brackish, salt inland swamps and lakes; flooded and irrigated paddocks, sewage farms and commercial saltfields.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or floodplains. Rare and intermittent occurrences during seasonal movements cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Sooty Owl (<i>Tyto tenebricosa</i>)	V	-	No	Ecosystem credit / Species credit Species: presence of caves/clifflines/ledges and/or living or dead trees with hollows greater than 20cm diameter actively being used Ecosystem credit: all 'other habitat'	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (<i>Pseudocheirus peregrinus</i>) or Sugar Glider (<i>Petaurus breviceps</i>). Nests in very large tree-hollows.	BioNet	Low - This species prefers rainforest type habitats, of which do not occur within in study area. No records within close proximity.	No
Speckled Warbler (<i>Chthonicola sagittata</i>)	V	-	No	Ecosystem credit	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	BAM-C	Low – marginal habitat in association with Landsdowne. Typically occurs on hills and tablelands of Dividing Range. Often require large remnant patches of habitat to persist. Rare or intermittent occurrences cannot be discounted.	No
Spectacled Monarch (<i>Monarcha trivirgatus</i>)	-	M, Ma	No	-	Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed.	PMST	Low – preferred habitat not within study area. Rare and intermittent occurrences cannot be discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Spotted Harrier (<i>Circus assimilis</i>)	V	-	No	Ecosystem credit	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Preys on terrestrial mammals (e.g. bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.	BAM-C, BioNet	Low - a western plains species that sometimes extends its range to near coastal locations. However, there is marginal habitat available in the vicinity of the study area, and intermittent or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	No
Square-tailed Kite (<i>Lophoictinia isura</i>)	V	-	No	Ecosystem credit / Species credit Species: actively used nest trees Ecosystem credit: all 'other habitat'	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	BAM-C, BioNet	Low - Marginal foraging habitat available in the vicinity of the study area. Intermittent or rare occurrences under suitable conditions cannot be entirely discounted.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Superb Fruit-dove (<i>Ptilinopus superbus</i>)	V	-	No	Ecosystem credit	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic.	BAM-C	Low - There is no suitable habitat within the study area (rainforest habitats), however rare occurrences within the study area cannot be discounted.	No
Swift Parrot (<i>Lathamus discolor</i>)	E1	CE, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Bloodwood (<i>C. gummifera</i>), Mugga Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>). Commonly used lerp infested trees include Inland Grey Box (<i>E. macrocarpa</i>), Grey Box (<i>E. moluccana</i>) and Blackbutt (<i>E. pilularis</i>).	BAM-C, BioNet, PMST	Moderate – potential habitat within the study area. May occur within study during seasonal movements when blossom resources are in abundance.	Yes
Turquoise Parrot (<i>Neophema pulchella</i>)	V	-	No	Ecosystem credit	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	BAM-C, BioNet	Low - It is unlikely to occur with the study area due to a lack of local records, suitable habitat, and it is outside the species normal distribution.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	V	-	No	Ecosystem credit	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	BAM-C, BioNet	Moderate - Potential habitat available in study area. Recorded within the greater locality.	Yes
White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)	V	Ma	No	Ecosystem credit / Species credit Species: presence of living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines actively being used Ecosystem credit: all 'other habitat'	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. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Feed mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion.	BAM-C, BioNet, PMST	Moderate – seen foraging along Georges River off-site. No nesting was observed or potential nesting trees observed within study area.	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
White-fronted Chat (<i>Epthianura albifrons</i>)	E2, V	-	No	E2: Species credit V: Ecosystem credit	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. 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. Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which the Chats are unlikely to fly. The nearest extant populations outside Sydney Metropolitan CMA are at Ash Island north of Newcastle and Lake Illawarra, south of Wollongong. White-fronted Chats were previously recorded at Penrith Lakes (2001), Hawkesbury Swamps (2002), Tuggerah Lake (1997) and Lake Macquarie (1998).	BAM-C	Low - This species is unlikely to occur within the study area as there is no suitable habitat. Known to occur within the Sydney Metropolitan Catchment, accidental or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	No
White-throated Needletail (<i>Hirundapus caudacutus</i>)	-	V, M, Ma	No	Species credit	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April.	PMST, BioNet	Moderate - May occur over the study area on a seasonal basis, but unlikely to use terrestrial habitats in the study area.	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Yellow Wagtail (<i>Motacilla flava</i>)	-	M, Ma	No	-	This species occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. This species also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. This species migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and in QLD and the north of NT and WA.	PMST	Low – preferred habitat within study area limited. Rare and intermittent occurrences cannot be discounted.	No
Mammals								
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	E1	V	Yes	Species credit: presence of land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines	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. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.	PMST	Low - Suitable habitat not available within the study area. This species has not been previously recorded within locality. The study area is outside its normal distribution which tends to be associated with the Great Dividing Range.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Large Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	V	-	Yes	Ecosystem credit / Species credit Species: presence of cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding Ecosystem credit: all 'other habitat'	This species is found along the east coast of Australia from Cape York in Queensland to Castlemaine in Victoria. Habitat includes rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands. Roosts in caves, old mines, stormwater channels and sometimes buildings with populations centred on maternity caves that are used annually for the birth and development of young.	BAM-C, BioNet	Moderate - potential foraging available within the vicinity of the study area. Recorded within the wider locality. Species not recorded during targeted surveys. No roosting or breeding habitat recorded.	Yes
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	-	No	Ecosystem credit	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	BAM-C, BioNet	Moderate – This species prefers moist habitats, with trees taller than 20m. Some marginal habitat within the study area, potential to forage as part of greater home range. Records within the wider locality.	Yes
Eastern Coastal Free-tailed bat (<i>Mormopterus norfolkensis</i>)	V	-	No	Ecosystem credit	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur 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 or in man-made structures.	BAM-C, BioNet	Moderate - potential foraging available within the vicinity of the study area. Recorded within the wider locality.	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Eastern Pygmy-possum (<i>Cercartetus nanus</i>)	V	-	No	Species credit	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	BAM-C, BioNet	Moderate – patches of quality habitat found within/near the subject site. However, due to the isolation/segmentation of the habitat it may not be optimal. No individuals recorded during the survey.	Yes
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	No	Ecosystem credit	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3-6m.	BAM-C, BioNet	Moderate – more commonly found in tall wet forest which are not available within the study area. However, the species may forage within the vicinity of the study area, i.e. Georges River	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Greater Glider (<i>Petauroides volans</i>)	-	V	No	Species credit	The Greater Glider has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands, feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. It also favours forests with a diversity of eucalypts to cater for seasonal variation in food abundance.	PMST	Low - This species has not been previously recorded within locality. Study area is majority disturbed, and disjunct from major patches of intact vegetation. This species unlikely to occur as the study area is too isolated from known populations to the south.	No
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	No	Ecosystem credit / Species credit Species: breeding camps Ecosystem credit: all 'other habitat'	Grey-headed Flying-foxes are generally found within 200km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. 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 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Can travel up to 50km from the camp to forage; commuting distances are more often <20km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	BAM-C, BioNet, PMST	Moderate – Recorded foraging off-site. No known roost sites or established camps within the study area. The closest known GHFF camp is at Cabramatta.	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Koala (<i>Phascolarctos cinereus</i>)	V	V	No	Ecosystem credit / Species credit Species: areas identified via survey as important habitat Ecosystem credit: all 'other habitat'	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. It was briefly historically abundant in the 1890s in the Bega District on the south coast of NSW, although not elsewhere, but it now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Some preferred species include Forest Red Gum, Grey Gum. In coastal areas, Tallowwood and Swamp Mahogany are important food species, while in inland areas White Box, Bimble Box and River Red Gum are favoured. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	BAM-C, BioNet, PMST	Low - This species has not been previously recorded within locality. Study area is fairly disturbed, and disjunct from major patches of intact vegetation. Closest records are at Sandy Point on the other side of the Georges River in association with Campbelltown LGA population.	No
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	Yes	Species credit: areas within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	BAM-C, BioNet, PMST	Low - No roosting habitat (i.e. cliffs and sandstone rocky outcrops/caves) recorded within study area. Potential foraging available within the of the study area.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Little Bent-winged Bat (<i>Miniopterus australis</i>)	V	-	Yes	Ecosystem credit / Species credit Species: presence of cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding Ecosystem credit: all 'other habitat'	Found along east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. 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. Only five nursery sites /maternity colonies are known in Australia.	BAM-C, BioNet	Moderate - potential marginal foraging available within the vicinity of the study area. Species not recorded during targeted surveys. No roosting or breeding habitat recorded.	Yes
Long-nosed Potoroo (<i>Pototous tridactylus tridactylus</i>)	V	V	No	Species credit	Widely but patchily distributed along the southeastern coast of mainland Australia, from south-eastern South Australia through Victoria and New South Wales to south-eastern Queensland. Recent records indicate that the westerly range of the species in NSW is within 140km of the coast. The stronghold of its northern distribution is along the foothills and eastern ranges of the Great Divide in northern NSW and southern Queensland. However, on the lowlands of the far north coast of NSW, the species has been progressively lost from habitat remnants (Andren et al. 2013).	PMST	Low - marginal habitat, preferred habitat of heathy understory limited. This species unlikely to occur as the study area is too isolated from known populations and records.	No
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	-	V	No	Ecosystem credit	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Genetic evidence indicates that the New Holland Mouse once formed a single continuous population on mainland Australia and the distribution of recent subfossils further suggest that the species has undergone a large range contraction since European settlement. Total population size of mature individuals is now estimated to be less than 10,000 individuals although, given the number of sites from which the species is known to have disappeared between 1999 and 2009, it is likely that the species' distribution is actually smaller than current estimates. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.	PMST	Low – marginal habitat, preferred habitat of heathy understory limited. No records within the locality. This species unlikely to occur as the study area is too isolated from known populations and records to the south in Royal National Park.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Southern Brown Bandicoot (<i>Isodon obesulus</i>)	E1	E	No	Species credit: requires dense ground cover in a variety of habitats.	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruited) fungi. Their searches for food often create distinctive conical holes in the soil. Males have a home range of approximately 5-20 hectares whilst females forage over smaller areas of about 2-3 hectares.	BioNet PMST	Low – marginal habitat, preferred habitat of heathy understory limited. This species unlikely to occur as the study area is too isolated from known populations and records.	No
Southern Myotis (<i>Myotis macropus</i>)	V	-	No	Species credit: areas within 200 m of riparian zone; bridges, caves or artificial structures within 200 m of riparian zone; riparian zones include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally, roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	BAM-C, BioNet	Recorded - An individual was identified utilising one culvert along the Georges River. It is also likely that the species may be utilising native vegetation and waterbodies surrounding these potential artificial roosting sites within the study area.	Yes
Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)	V	E	No	Ecosystem credit	Found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are known to traverse their home ranges along densely vegetated creeklines.	BAM-C, PMST	Low - No records within the locality. Study area disturbed and isolated from major patches of intact vegetation.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Squirrel Glider (<i>Petaurus norfolcensis</i>)	V	-	No	Species credit: presence of hollow-bearing trees	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	BAM-C	Low - Despite targeted surveys the species has not been previously recorded within locality. Study area is fairly disturbed, and disjunct from major patches of intact vegetation.	No
Yellow-bellied Glider (<i>Petaurus australis</i>)	V	-	No	Ecosystem credit	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	BAM-C	Low - This species has not been previously recorded within locality. Study area is majority disturbed, and disjunct from major patches of intact vegetation. This species unlikely to occur as the study area is too isolated from known populations to the south.	No
Yellow-bellied Sheath-tail Bat (<i>Saccolaimus flaviventris</i>)	V	-	No	Ecosystem credit	The Yellow-bellied Sheath-tail-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. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	BAM-C, BioNet	Moderate - Potential foraging habitat available within the vicinity of the study area. Records within the locality to the south of Holsworthy military base.	Yes

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Invertebrates								
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	E1	-	No	Species credit	Lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. known from over 100 different locations, but not all are currently occupied, and they are usually isolated from each other as a result of land use patterns. Primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	BAM-C, BioNet	Low – absence of snails or shells from field survey	No
Dural Woodland Snail (<i>Pommerhelix duralensis</i>)	E1	E	No	Species credit	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species is definitely found within the Local Government Areas of The Hills Shire, Hawkesbury Shire and Hornsby Shire. Records from the Blue Mountains City, Penrith City and Parramatta City may represent this species. The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris. Migration and dispersal is limited, with overnight straight-line distances of under 1 metre identified in the literature and studies. The main food sources are hyphae and fruiting bodies of native fungi. It is possible other detritus may be consumed.	BAM-C, PMST	Low - Outside known species distribution and it has not been recorded within the locality.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Fish								
Black Rock Cod <i>Epinephelus damelii</i>	V (FM Act)	V	N/A	N/A	The Black Rockcod is found in warm temperate and subtropical parts of the south-western Pacific. Adult Black Rockcod can grow to 2 m in length and at least 80 kg in weight, but it is more common to see smaller fish (up to 1m/30kg).	PMST	Low - the study area does not contain estuarine habitats or is immediately adjacent to those habitats	No
Macquarie Perch <i>Macquaria australasica</i>	E (FM Act)	E	N/A	N/A	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments. Macquarie Perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water). (Department of the Environment, 2016b) (Department of Primary Industries, 2016)	PMST	Low - no suitable habitats within or immediately adjacent to suitable habitats.	No
Invertrabets								
Golden Sun Moth <i>Synemon plana</i>	E	CE	Yes	Species Credit	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses <i>Austrodanthonia</i> spp.	PMST	Low – no suitable habitat in the form of grasslands occurs within the study area.	No

Common Name (<i>Scientific Name</i>)	BC Act ¹	EPBC Act ²	SAII ³	Ecosystem or species credit species?	Habitat requirements	Data source ⁴	Likelihood of occurrence	Significant impact assessment required?
Reptiles								
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	E1	V	Yes	Ecosystem credit / Species credit Species: areas including escapments, outcrops and pogodas within the Sydney Sandstone geologies Ecosystem credit: all 'other habitat'	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250km of Sydney. 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 cervices or hollows in large trees within 500m of escarpments in summer.	PMST	Low - associated with exposed cliff edges and sandstone rock outcropping, where it shelters in rock crevices and under flat sandstone rocks during autumn, winter and spring. During summer, this species seeks shelter in hollows of large trees within 500 m of their escarpment habitat. The study area did not comprise habitat suitable for this species.	No
Rosenberg's Goanna (<i>Varanus rosenbergi</i>)	V	-	No	Ecosystem credit	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	BAM-C	Low - Critical habitat components include termite mounds, within which this species nests. The study area does not comprise appropriate habitat for this species.	No

- (1) Listed under the NSW Biodiversity Conservation Act 2016 – E4 = Presumed extinct, CE = Critically Endangered, E1 = Endangered Species, E2 = Endangered Population, V = Vulnerable
- (2) SAII = Serious and Irreversible Impact entity under BAM
- (3) Listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 – X = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory
- (4) Bionet = OEH Bionet Atlas of NSW Wildlife, PMST = EPBC Act Protected Matters Search Tool, PlantNet = Royal Botanic Gardens PlantNet Spatial Search and BAM-C = Biodiversity Assessment Method Calculator output.

Appendix C – Test of significance

The REF Proposal will be assessed under Part 5 Division 5.1 of the EP&A Act. Under this assessment, Section 7.3 of the BC Act requires that a test of significance is undertaken to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the BC Act.

Assessment of habitat to be impacted upon by the REF Proposal found that there is potential within the study area for threatened biodiversity to occur. The following species have been assessed as part of this REF Proposal:

- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – BC Act
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion – EPBC Act
- River – Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – BC Act
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria – EPBC Act
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – BC Act
- Coastal Swamp Oak (*Casuarina glauca*) Forest of the New South Wales and South East Queensland – EPBC Act
- *Acacia pubescens* (Downy Wattle)
- *Callistemon linearifolius* (Netted Bottle Brush)
- Dusky Woodswallow
- Eastern Osprey
- Little Lorikeet
- Swift Parrot
- Varied Sitella
- White-bellied Sea Eagle
- White-throated Needletail
- Cave-dwelling micro bats:
 - Large Bent-winged Bat
 - Little Bent-winged Bat
 - Southern Myotis
- Hollow-dwelling micro bats
 - Eastern False Pipistrelle
 - Eastern Coastal Free-tailed Bat
 - Greater Broad-nosed Bat
 - Yellow-bellied Sheath-tail Bat
- Eastern Pygmy-possum
- Grey-headed Flying Fox

For threatened biodiversity under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999) significance assessments have been completed in accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment Water Heritage and the Arts, 2013). Species listed under both the BC Act and the EPBC Act has been assessed using both assessment guidelines separately.

The following assessments were undertaken to consider impacts of works associated with the REF proposal upon threatened species, populations or communities with a moderate or greater likelihood of occurring within the REF proposal area.

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – BC Act

Status

Cooks River/Castlereagh Ironbark Forest (CRCIF) in the Sydney Basin Bioregion is listed as endangered on the BC Act

Specific impacts

The REF proposal may require the clearing of 0.21 ha of Cooks River/Castlereagh Ironbark Forest.

In the case of a Threatened species, whether the action proposed 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

Not applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **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**
- **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**

The REF proposal is likely to impact approximately 0.21 ha of CRCIF. This TEC occurs on either side of Milperra Road. The impact is small and will involve removal a linear strip of vegetation along the existing road corridor of Milperra Road. Approximately 2.62 ha of this TEC would be retained within the study area, 93% retention of this TEC within the study area. The vegetation recorded is in a relatively intact condition although has exhibited previous disturbances and ongoing edge effects from Milperra Road, Bankstown Airport and surrounding commercial, industrial and recreational land uses.

Due to the small area as result of the REF proposal that may be impacted, the removal would occur as a linear impact and is unlikely to involve an increase in the modification of the TEC than is already occurring it is considered unlikely that the REF proposal would have an adverse effect on the extent of CRCIF or substantially and adversely modify the composition of CRCIF such that its local occurrence is likely to be placed at risk of extinction.

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

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the REF proposal, and**

The REF proposal is likely to impact upon 0.21 ha of CRCIF.

The CRCIF occurs on both sides of Milperra Road with one isolated small patch to the east near Henry Lawson Drive. The REF proposal will involve the clearing of a linear strip of vegetation from the existing road corridor.

Fragmentation of this TEC is unlikely as the impact is linear in nature and will involve the widening of Milperra Road. The final extent and level of impact will be confirmed once a final design has been selected with the aim of reducing potential impacts managed through recommended mitigation measures. Therefore, the REF proposal is unlikely to increase fragmentation of this TEC and it unlikely to become fragmented or isolated from other areas of habitat.

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

Within locality of the study area, approximately 2.33 ha of CRCIF has been mapped. Within the REF proposal area 0.21 ha is likely to be impacted upon, representing approximately 7% of CRCIF mapped within study area. The existing area of CRCIF is subject to edge effects from Milperra Road. The CRCIF recorded is in a relatively intact condition although previous disturbances and ongoing edge effects from Milperra Road, Bankstown Airport and surrounding commercial, industrial and recreational land uses. The area to be removed occurs as a linear impact along Milperra Road and is unlikely to be of high importance to the long-term survival of CRCIF within the locality.

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

Areas of outstanding biodiversity value (AOBVs) refers to those areas of land listed in under the Biodiversity Conservation Act, these areas contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. No AOBVs has been listed for CRCIF.

- **whether the proposed development constitutes or is part of a Key Threatening Process or is likely to result to increase the impact of a Key Threatening Process.**

The REF proposal may directly contribute to the following Key Threatened Processes listed under the BC Act:

- clearing of Native Vegetation
- loss of hollow-bearing trees
- removal of dead wood and dead trees.

The action proposed may indirectly contribute to the following additional Key Threatening Processes:

- infection of native plants by *phytophthora cinnamomi*
- introduction and establishment of exotic rust fungi of the order pucciniales pathogenic on plants of the family Myrtaceae
- invasion of native plant communities by exotic perennial grasses

Mitigation measures outlined in Section 5 of the main report have been recommended to decrease the impact of the Key Threatening Process the REF proposal may indirectly contribute to.

Conclusion

Within the study area 2.62 ha of Cooks River/Castlereagh Ironbark Forest was recorded within the study area. The REF proposal may impact upon 0.21 ha (7%) of the extent within the study area. The TEC is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion – EPBC Act

Status

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion is listed as a threatened ecological community under the EPBC Act, with a status of Critically Endangered.

Specific impacts

The REF proposal may require the removal of up to 0.21 ha of CRCIF.

The assessment in Section 3.13.2 assessed the area likely to be impacted, defined as patch 3 as meeting the criteria for the Category C high condition class for the EPBC Act listing of CRCIF. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- **reduce the extent of an ecological community**
- **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The REF proposal is likely to impact 0.21 ha of CRCIF listed under the EPBC Act.

The REF proposal would not break apart the continuous area of CRCIF that is likely to be impacted. The impact is small, linear and will involve linear vegetation widening of Milperra Road. Following construction, vegetation connectivity would be maintained, including opportunities to rehabilitate CRCIF. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible. Therefore, the REF proposal is unlikely to increase fragmentation of the patch and it is unlikely to have a real chance that it will increase fragmentation.

- **adversely affect habitat critical to the survival of an ecological community**

The Approved Conservation Advice for CRCIF states that the habitat most critical to the survival of the CRCIF consists of those patches that meet the moderate condition or higher.

The area of impact (patch 3) was assessed as being in category c - high condition (Section 3.13.2). Whilst the area that may be impacted upon is in high condition, the area to be removed is minor (0.21 ha), occurs as a linear strip and would not fragment or isolate any areas of CRCIF. Therefore, the CRCIF that may be impacted upon is unlikely to be critical to the survival of CRCIF.

- **modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

The REF proposal is likely to involve subsurface construction work due to the installation of a drainage infrastructure under Milperra Road within the adjoining PCT of Freshwater Wetlands. The subsurface works are unlikely to intersect the groundwater due to the shallow nature of the excavations (Aurecon, 2021). These excavations could mobilise potential contaminants that may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the REF proposal. Whilst the REF proposal may increase water surface drainage and has the potential to mobilise contaminants to the CRCIF, these would be reduced and managed through recommended mitigation measures. These impacts are unlikely to significantly modify abiotic factors such as the soil profile, and surface water drainage patterns necessary to the survival of vegetation within CRCIF and the surrounding vegetation.

- **cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

CRCIF within REF proposal area is located on either side of Milperra Road. As such, the CRCIF is currently subject to edge effects from Milperra Road. Whilst the REF proposal may have the potential to introduce edge effects, these would be reduced and managed through recommended mitigation measures.

The REF proposal does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods or flora/fauna harvesting.

The REF proposal is considered unlikely to cause a substantial change in the species composition of CRCIF.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

The REF proposal has the potential to result in minor increases in the establishment, density or diversity of weed species. The REF proposal area containing CRCIF occurs on either side of Milperra Road and is currently subject to weed invasion. However, the PCT is in high condition and weeds may encroach into new areas post construction. Recommended mitigation measures are to be implemented to mitigate any impact of invasive species to the CRCIF. As such, the REF proposal is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence.

The REF proposal is likely to involve subsurface construction work due to the installation of a culvert under Milperra Road within the adjoining freshwater wetlands (PCT 781). These excavations could mobilise potential contaminants that may be present within the subsurface soils. Bankstown Airport occurs to the north of Milperra Road. Bankstown Airport maybe a source of sedimentation runoff and/or pollutants. If so, then this is already occurring and the REF proposal is unlikely to result in any substantial increase of contaminants than is already occurring. Recommended mitigation measures are to be implemented to reduce the any impacts from contaminants. The REF proposal is unlikely to kill or inhibit the growth of species within the CRCIF such that it would substantially reduce the quality or integrity of the community's occurrence.

The REF proposal does not involve other processes that are likely to reduce the quality or integrity of CRCIF other than those described above.

- **Interfere with the recovery of an ecological community**

Currently there is no recovery plan for CRCIF.

Conclusion

The REF proposal may require the removal of up to 0.21 ha of high condition CRCIF consistent with the EPBC Act listing. Whilst the area that may be impacted upon is in high condition, the area to be removed is small and would not result in fragmentation, isolation or impact to any critical habitat. The ecological community is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

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

Status

River-flat Eucalypt Forest (RFEF) on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as endangered on the BC Act

Specific impacts

The REF proposal may require the clearing of 0.96 ha of River-flat Eucalypt Forest comprising of the following:

- 0.77 ha – PCT 835 – Forest Red gum variant
- 0.19 ha – PCT 835 – Blue Box variant

In the case of a Threatened species, whether the action proposed 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

Not applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **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**
- **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**

The REF proposal is likely to impact approximately 0.96 ha of RFEF. This TEC occurs on either side of Henry Lawson Drive extending from the south to north of the study area. The impact will involve removal a linear strip of patches of this TEC from the south at Auld Avenue to the northern end of the study area. A total of 2.96 ha of RFEF occurs within the study area, the REF proposal would impact upon 0.96 ha this potential impact equates to 32% impact and 68% retention of this TEC within the study area.

This TEC varies in condition, having moderate weed incursions, managed understories and in relatively intact conditions. Due to the small area of potential impact as result of the REF proposal, the removal would occur as a linear impact and is unlikely to involve an increase in the modification of the TEC than is already occurring it is considered unlikely that the REF proposal would have an adverse effect on the extent of RFEF or substantially and adversely modify the composition of RFEF such that its local occurrence is likely to be placed at risk of extinction.

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

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The REF proposal may require the removal of up to 0.96 ha of RFEF.

RFEF occurs in the road corridor of Henry Lawson Drive in distinct patches. The REF proposal will involve the clearing of a linear strip of vegetation from the existing road corridor.

Fragmentation of this TEC is unlikely as the impact is linear in nature and the REF proposal is unlikely to further fragment this TEC.

The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible Therefore, the REF proposal is unlikely to increase

fragmentation for RFEF and it is unlikely to become fragmented or isolated from other areas of habitat.

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

Within the study area, approximately 2.96 ha of RFEF has been mapped. Within the REF proposal area 0.96 ha is likely to be impacted upon, representing approximately 38% of RFEF mapped within study area. The existing area of RFEF is subject to edge effects from Henry Lawson Drive. Furthermore, the study area is surrounded by urban development, industrial land uses, golf courses and Bankstown Airport. These land uses could be sources of contaminants that are impacting upon the quality of this TEC. The area to be removed occurs as a linear impact along Henry Lawson Drive and is unlikely to be of high importance to the long-term survival of RFEF within the locality.

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

Areas of outstanding biodiversity value (AOBVs) refers to those areas of land listed in under the Biodiversity Conservation Act, these areas contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. No AOBVs has been listed for RFEF.

- **whether the proposed development constitutes or is part of a Key Threatening Process or is likely to result to increase the impact of a Key Threatening Process.**

The REF proposal may directly contribute to the following Key Threatened Processes listed under the BC Act:

- clearing of Native Vegetation
- loss of hollow-bearing trees
- removal of dead wood and dead trees.

The action proposed may indirectly contribute to the following additional Key Threatening Processes:

- infection of native plants by *phytophthora cinnamomi*
- introduction and establishment of exotic rust fungi of the order pucciniales pathogenic on plants of the family Myrtaceae
- invasion of native plant communities by exotic perennial grasses

Mitigation measures outlined in Section 5 of the main report have been recommended to decrease the impact of the Key Threatening Process the REF proposal may indirectly contribute to.

Conclusion

Within the study area 2.96 ha of RFEF was identified within the study area. The REF proposal may impact upon 0.96 ha (38%) of the extent within the study area. The TEC is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

EPBC Act Assessment

River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria

Status

River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria (RFEF) is listed as a threatened ecological community under the EPBC Act, with a status of Critically Endangered.

Specific impacts

The REF proposal may require the removal of up to 0.96 ha of RFEF.

The field surveys recorded PCT 835 within the study area which was assessed in Section 3.13.2 (Patches 1, 2 & 3) as meeting the criteria for the EPBC Act listing of RFEF. This TEC was assessed as being in moderate condition – Class C2. However, no data for patch 1 and 3 was collected at the time of the survey (this TEC wasn't listed at the time of the survey) therefore, a precautionary measure was undertaken and it has been assessed as being commensurate with the EPBC Act listing. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- **reduce the extent of an ecological community**
- **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The REF proposal is likely to impact 0.96 ha of RFEF listed under the EPBC Act. The impact is small, linear and will involve widening of Henry Lawson Drive. Following construction, vegetation connectivity would be maintained, including opportunities to rehabilitate RFEF. Fragmentation of this TEC is unlikely as the impact is linear in nature and will involve the widening of Henry Lawson Drive. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible. Therefore, the REF proposal is unlikely to increase fragmentation of the patch and it is unlikely to have a significant impact on RFEF.

- **adversely affect habitat critical to the survival of an ecological community**

The Approved Conservation Advice for RFEF states that the habitat most critical to the survival of the ecological community consists of those patches that are of a reasonable size and in the best condition. These represent those parts of the ecological community closest to the benchmark or reference state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function (Department of Agriculture, Water, and the Environment, 2020).

The PCT associated with RFEF (PCT 835) was assessed as being in moderate condition as it meets the majority of the state benchmarks (Table 5.10). The area to be removed is minor (0.96 ha) and therefore the RFEF that is likely to be impacted is unlikely to be critical to the survival of RFEF.

- **modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

The REF proposal is likely to involve subsurface construction work due to the extension of existing culverts and installation of new drainage infrastructure under Henry Lawson Drive and the installation of a new bridge over Milperra drain on Henry Lawson Drive which occurs to the south of

Auld Avenue. These construction works have the potential could mobilise potential contaminants that may be present within the subsurface soils and within the creekline. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the REF proposal. Whilst the REF proposal may increase water surface drainage and has the potential to mobilise contaminants to the RFEF within the REF proposal area, these would be reduced and managed through recommended mitigation measures including the implementation of operational water quality controls. These impacts are unlikely to significantly modify abiotic factors such as the soil profile, and surface water drainage patterns necessary to the survival of vegetation within the study area and the surrounding vegetation.

- **cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

RFEF within REF proposal study is located on the edge of Henry Lawson Drive. As such, the RFEF is currently subject to edge effects from Henry Lawson Drive. Whilst the REF proposal may have the potential to introduce edge effects, these would be reduced and managed through recommended mitigation measures.

The REF proposal does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods or flora/fauna harvesting.

The REF proposal is considered unlikely to cause a substantial change in the species composition of RFEF.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

The REF proposal has the potential to result in minor increases in the establishment, density or diversity of weed species. The REF proposal area containing RFEF occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in the establishment of weed species. Recommended mitigation measures are to be implemented to mitigate any impact of invasive species to the RFEF. As such, the REF proposal is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence.

The REF proposal is likely to involve subsurface construction work due to the installation of a drainage infrastructure and the construction of a new bridge over Milperra Drain. These construction works could mobilise potential contaminants that may be present within the subsurface soils and Milperra drain. The Georges River Golf Course and Bankstown Golf Course occur on the eastern side of Henry Lawson Drive. These golf courses could be a source of fertilisers and herbicides. If so, then this is already occurring and the REF proposal, inclusive of its operational water quality controls, is unlikely to result in any substantially increase of these contaminants than is already occurring. Recommended mitigation measures are to be implemented to reduce the any impacts from contaminants. The REF proposal is unlikely to kill or inhibit the growth of species within the RFEF such that it would substantially reduce the quality or integrity of the community's occurrence.

The REF proposal does not involve other processes that are likely to reduce the quality or integrity of RFEF other than those described above.

Interfere with the recovery of an ecological community

Currently there is no recovery plan for RFEF. The Approved Conservation Advice outlined four priority conservation actions (Section 5.4, Department of the Agriculture, Water and the Environment, 2020). The REF proposal is likely to interfere with one priority conservation action being *Protect the ecological community from further losses*.

Conclusion

The REF proposal may require the removal of up to 0.96 ha of RFEF consistent with the EPBC Act listing. The ecological community is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

Swamp Oak Floodplain Forest of NSW and South East Corner Bioregions

Status

Swamp Oak Floodplain Forest (SOFF) of the New South Wales and South East Corner Bioregions is listed as endangered on the BC Act and endangered on the EPBC Act.

Specific impacts

The REF proposal may require the clearing of 0.45 ha of Swamp Oak Floodplain Forest. Comprising of the following PCTs:

- 0.14 ha of PCT 1236 Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- 0.10 ha of PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner
- 0.21 ha of PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

Section 7.3 Test of Significance

In the case of a Threatened species, whether the action proposed 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

Not applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **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**
- **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**

The REF proposal is likely to impact approximately 0.45 ha of SOFF. This TEC occurs in the REF proposal area in three patches. The first to the south of Auld Avenue, the second on either side of Milperra Road and the third in the north of the study area along the banks of the Georges River.

The impact will involve removal a linear strip of these patches, with two small patches to be removed completely to the south of Auld Avenue. One patch in the north of the study area will involve the removal of a small area adjoining the Georges River. Approximately 2.22 ha of SOFF occurs within the study area. Therefore, the removal of SOFF within the REF proposal area equates to a 20% reduction of the extent of SOFF within the study area.

This TEC occurred in two conditions being moderate and poor. The small patches to be entirely removed are small and with the one south of Auld Avenue being in poor condition.

Due to the small area of potential impact as result of the REF proposal, the removal would occur as a linear impact and is unlikely to involve an increase in the modification of the TEC than is already occurring it is considered unlikely that the REF proposal would have an adverse effect on the extent of SOFF or substantially and adversely modify the composition of SOFF such that its local occurrence is likely to be placed at risk of extinction.

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

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The REF proposal may require the removal of up to 0.45 ha of SOFF.

SOFF occurs in the road corridor of Henry Lawson Drive and Milperra Road in distinct patches. The REF proposal will involve the clearing of a linear strip of vegetation from the existing road corridor. Fragmentation of this TEC is unlikely as the impact is linear in nature and the REF proposal is unlikely to further fragment this TEC. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible. Therefore, the REF proposal is unlikely to increase fragmentation for SOFF and it is unlikely to become fragmented or isolated from other areas of habitat.

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

Within the study area, approximately 0.45 ha of SOFF has been mapped. Within the REF proposal study area 0.96 ha is likely to be impacted upon, representing approximately 20% of SOFF mapped within study area. The existing area of SOFF is subject to edge effects from Henry Lawson Drive and Auld Avenue. Furthermore, the study area is surrounded by urban development, industrial land uses, golf courses and Bankstown Airport. These land uses could be sources of contaminants that are impacting upon the quality of this TEC. The area to be removed occurs as a linear impact along Henry Lawson Drive and is unlikely to be of high importance to the long-term survival of SOFF within the locality.

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

Areas of outstanding biodiversity value (AOBVs) refers to those areas of land listed in under the Biodiversity Conservation Act, these areas contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. No AOBVs has been listed for SOFF.

- **whether the proposed development constitutes or is part of a Key Threatening Process or is likely to result to increase the impact of a Key Threatening Process.**

The REF proposal may directly contribute to the following Key Threatened Processes listed under the BC Act:

- clearing of Native Vegetation
- loss of hollow-bearing trees
- removal of dead wood and dead trees.

The action proposed may indirectly contribute to the following additional Key Threatening Processes:

- infection of native plants by *phytophthora cinnamomi*
- introduction and establishment of exotic rust fungi of the order pucciniales pathogenic on plants of the family Myrtaceae
- invasion of native plant communities by exotic perennial grasses

Mitigation measures outlined in Section 5 of the main report have been recommended to decrease the impact of the Key Threatening Process the REF proposal may indirectly contribute to.

Conclusion

Within the study area 2.22 ha of SOFF was identified within the study area. The REF proposal may impact upon 0.45 ha (20%) of the extent within the study area. The TEC is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland

Status

Coastal Swamp Oak (*Casuarina glauca*) Forest (CSOF) of New South Wales and South East Queensland is listed as a threatened ecological community under the EPBC Act, with a status of Endangered.

Specific impacts

The REF proposal may require the removal of up to 0.10 ha of CSOF.

PCT 1234 that was mapped within the study area was assessed in Section 3.13.2 as meeting the criteria for the EPBC Act listing of CSOF. The CSOF in the study area was assessed as being in moderate quality – Category C condition of the criteria for SOFF listed as endangered under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real changes or possibility that it will:

- **reduce the extent of an ecological community**
- **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The REF proposal is likely to impact upon 0.10 ha of CSOF listed under the EPBC Act.

The impact is small and will involve widening of Henry Lawson Drive and the removal of a small patch in the northern section of the REF proposal area. Minor fragmentation of this TEC may occur as a result of the REF proposal due to the small patch located in the northern portion of the REF proposal area. This area is small and would not cause a barrier to fauna movements or impact upon flora breeding, dispersal of pollinators or the dispersal of plant propagules. The remaining area of impact is linear in nature involving the removal vegetation along the edge of Henry Lawson Drive and would not fragment or isolate any areas of CSOF. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible. Therefore, the REF proposal is unlikely to increase fragmentation of the patch and it unlikely to have a significant impact on CSOF.

- **adversely affect habitat critical to the survival of an ecological community**

The Approved Conservation Advice for CSOF states that the habitat most critical to the survival of the ecological community consists of those patches that are of a reasonable size and in the best condition. These represent those parts of the ecological community closest to the benchmark or reference state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function (Department of the Environment and Energy, 2018).

The PCT associated with COSF (PCT 1234) was assessed as being in moderate condition as it meets some of the structure and function benchmarks. The area to be removed is minor (0.10 ha) and therefore the COSF that might be impacted is unlikely to be critical to the survival of COSF.

- **modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

The REF proposal is likely to involve subsurface construction work due to the installation of a culvert under Henry Lawson Drive within CSOF. The subsurface works are shallow in nature and are likely to intersect with the groundwater (Aurecon, 2021). These excavations could mobilise potential contaminants that may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the REF

proposal. Whilst the REF proposal may increase water surface drainage and has the potential to mobilise contaminants to the CSOF within the REF proposal area, these would be reduced and managed through recommended mitigation measures, including the implementation of operational water quality controls. These impacts are unlikely to significantly modify abiotic factors such as the soil profile, groundwater levels or surface water drainage patterns necessary to the survival of vegetation within and surrounding the REF proposal area.

- **cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

CSOF within REF proposal area is located on the edge of Henry Lawson Drive. As such, the CSOF is currently subject to edge effects from Henry Lawson Drive. Whilst the REF proposal has the potential to introduce edge effects, these would be reduced and managed through recommended mitigation measures.

The REF proposal does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods or flora/fauna harvesting.

The REF proposal is considered unlikely to cause a substantial change in the species composition of CSOF.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

The REF proposal has the potential to result in minor increases in the establishment, density or diversity of weed species. The REF proposal area containing CSOF occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in invasive species. Recommended mitigation measures are to be implemented to mitigate any impact of invasive species to the CSOF. As such, the REF proposal is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence.

The REF proposal is likely to involve subsurface construction work due to the installation of a culvert under Henry Lawson Drive within the CSOF. These excavations could mobilise potential contaminants that may be present within the subsurface soils. The Georges River Golf Course occurs on the eastern side of Henry Lawson Drive opposite the CSOF. This golf course could be a source of fertilisers and herbicides. If so, then this is already occurring and the REF proposal is unlikely to result in any substantial increase of these chemicals than is already occurring. Recommended mitigation measures are to be implemented to reduce the any impacts from contaminants, including the implementation of operational water quality controls. The REF proposal is unlikely to kill or inhibit the growth of species within the CSOF such that it would substantially reduce the quality or integrity of the community's occurrence.

The REF proposal does not involve other processes that are likely to reduce the quality or integrity of CSOF other than those described above.

Interfere with the recovery of an ecological community

Currently there is no recovery plan for CSOF. The Approved Conservation Advice outlined four priority conservation actions (Section 6.2, Department of the Environment and Energy, 2018). The REF proposal is likely to interfere with one priority conservation action being *conserve remaining patches*.

Conclusion

The REF proposal may require the removal of up to 0.10 ha of CSOF consistent with the EPBC Act listing. The ecological community is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

Status

Freshwater Wetlands (FW) on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as endangered on the BC Act.

Specific impacts

The REF proposal may require the clearing of 0.07 ha of Freshwater Wetlands.

Section 7.3 Test of Significance

In the case of a Threatened species, whether the action proposed 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

Not applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **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**
- **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**

The REF proposal is likely to impact approximately 0.07 ha of FWW. This TEC occurs in the REF proposal area in two patches. The first to the south of Auld Avenue on the eastern side of Henry Lawson Road and the second on the southern side of Milperra Road.

The impact will involve removal a linear strip of these patches, with two small patches to be removed completely to the south of Auld Avenue. Approximately 0.21 ha of FWW occurs within the study area. Therefore, the removal of FWW within the study area equates to a 33% reduction of the extent of FWW within the study area.

Due to the small area of potential impact as result of the REF proposal, the removal would occur as a linear impact and is unlikely to involve an increase in the modification of the TEC than is already occurring it is considered unlikely that the REF proposal would have an adverse effect on the extent of FWW or substantially and adversely modify the composition of FWW such that its local occurrence is likely to be placed at risk of extinction.

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

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The REF proposal may require the removal of up to 0.07 ha of FWW.

FWW occurs in road corridor of Henry Lawson Drive in two patches. The REF proposal will involve the clearing of a linear strip of vegetation from the existing road corridor.

Fragmentation of this TEC is unlikely as the impact is linear in nature and the REF proposal is unlikely to further fragment this TEC.

The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible. Therefore, the REF proposal is unlikely to increase fragmentation for FWW and it is unlikely to become fragmented or isolated from other areas of habitat.

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

Within the study area, approximately 0.21 ha of FWW has been mapped. Within the REF proposal area 0.07 ha is likely to be impacted upon, representing approximately 33% of FWW mapped within study area. The existing area of FWW is subject to edge effects from Henry Lawson Drive and Milperra Road. Furthermore, the study area is surrounded by urban development, industrial land uses, golf courses and Bankstown Airport. These land uses could be sources of contaminants that are impacting upon the quality of this TEC. The area to be removed occurs as a linear impact along Henry Lawson Drive and Milperra Road and is unlikely to be of high importance to the long-term survival of FWW within the locality.

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

Areas of outstanding biodiversity value (AOBVs) refers to those areas of land listed in under the Biodiversity Conservation Act, these areas contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. No AOBVs has been listed for FWW.

- **whether the proposed development constitutes or is part of a Key Threatening Process or is likely to result to increase the impact of a Key Threatening Process.**

The REF proposal may directly contribute to the following Key Threatened Processes listed under the BC Act:

- clearing of Native Vegetation
- loss of hollow-bearing trees
- removal of dead wood and dead trees.

The action proposed may indirectly contribute to the following additional Key Threatening Processes:

- infection of native plants by *phytophthora cinnamomi*
- introduction and establishment of exotic rust fungi of the order pucciniales pathogenic on plants of the family Myrtaceae
- invasion of native plant communities by exotic perennial grasses

Mitigation measures outlined in Section 5 of the main report have been recommended to decrease the impact of the Key Threatening Process the REF proposal may indirectly contribute to.

Conclusion

Within the study area 0.21 ha of FWW was identified within the study area. The REF proposal may impact 0.07 ha (33%) of the extent within the study area. The area to be removed is small and currently being impacted upon weed invasions. Therefore, this TEC is unlikely to be significantly impacted by the REF proposal. The final impact will be confirmed during detailed design with the aim of avoiding areas of high biodiversity value as far as possible.

Callistemon linearifolius (Netted Bottle Brush)

Callistemon linearifolius occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies (Robinson 1994, Fairley and Moore 2002, Harden 2002). Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (NSW Scientific Committee 1999).

Status

Callistemon linearifolius is listed as Vulnerable under the BC Act.

Specific impacts

The REF proposal would involve the disturbance of 23 individuals of *Callistemon linearifolius*, occurring within the study area along the edge of Milperra Road within PCT 725 Broad-leaved Ironbark *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain.

The following assessment has been undertaken following the *Threatened Species Test of Significance Guidelines* (Office of Environment & Heritage, 2018). Under the Act 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:

Section 7.3 Test of Significance

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 species is listed as 'data deficient' under the NSW 'Saving our Species' program so little is known about the life cycle of the species (Department of Planning, Industry and Environment, 2021). The REF proposal would involve the clearing of 23 individuals of this species. All of these individuals are growing on the edge of the habitat patch within the road corridor of Milperra Road and are subject to edge effects that limit the long-term viability of these plants. The local population of at least six plants within Ashford Reserve along with suitable habitat for species expansion will be retained post road upgrade. The proposed activity is considered unlikely to significantly affect processes such as pollination, seed dispersal and recruitment which could affect the breeding of a viable population of this species. The roadside plants to be removed are unlikely to have an adverse effect on the life cycle such that a local population is at risk of becoming extinct.

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

- **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**
- **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

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

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

The proposed development will involve the removal 23 individuals of *Callistemon linearifolius*.

- **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**

The REF proposal will involve the loss of 23 individuals of this species on the roadside and protection of six in the remnant bushland of Ashford Reserve. The REF proposal is likely to clear is a linear strip of *C. linearifolius* habitat occurring on the edge of the Milperra Road. These areas

are already subject to edge effects and weeds and pests and clearing would not result in increases in fragmentation. Although the REF proposal would shift the edge effects to adjacent areas, mitigation measures would be implemented to minimise weed spread, sedimentation/runoff changes to hydrology. The REF proposal is unlikely to fragment or isolate the existing habitat from other areas of habitat.

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

The habitat that may be impacted upon is located along the southern edge of Milperra Road which is currently subject to edge effects. Owing to the relatively small extent of habitat impact (0.21 ha of PCT 725) and the current condition of the habitat, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to be of high importance to the long-term survival of this species within the locality.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

Under the BC Act a Key Threatening Process (KTP) is 'a process that threatens, or that may threaten, the survival or evolutionary development of species or ecological communities'. Currently 38 Key Threatening Processes (KTPs) are listed for NSW (Office of Environment & Heritage, 2018).

Of relevance to the *C. linearifolius*, the REF proposal will involve the KTP of "clearing of native vegetation". There is also potential for the REF proposal to contribute to other KTPs involving the invasion of weed species. Mitigation measures would be implemented for the REF proposal to address impacts to biodiversity including rehabilitation (i.e. revegetation), prevention and management of weeds and pathogens, containment of sedimentation and runoff. KTPs will be limited through the implementation of mitigation measures.

Conclusion

The REF proposal may potential result in the removal of 23 individuals and habitat removal associated with the REF proposal. Six individuals of *Callistemon linearifolius* were recorded in Ashford Reserve and genetic material for this population will be retained along with soil seed bank and suitable habitat. The impacted individuals are all growing on the edge of the habitat patch and are subject to edge effects that limit the long term viability of these plants. The local population within Ashford Reserve along with suitable habitat for species expansion will be retained post road upgrade. A significant impact on this species and or its habitat is considered unlikely.

Dusky Woodswallow

Dusky Woodswallows are widespread in eastern, southern and south-western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.

Status

Dusky Woodswallow is listed as Vulnerable under the BC Act.

Specific impacts

Dusky Woodswallow is considered to have a moderate likelihood of occurring within the study area due to the presence of potential foraging habitat (open eucalypt forest). The REF proposal would involve the clearing of 1.17 ha of potential foraging habitat for this species.

The following assessment has been undertaken following the *Threatened Species Test of Significance Guidelines* (Office of Environment & Heritage, 2018). Under the Act 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:

Section 7.3 Test of Significance

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.

Dusky Woodswallow primarily inhabits dry, open eucalypt forests and woodlands where they forage for invertebrates, mainly insects, which are captured whilst hovering or sallying above the canopy or over water. Also, frequently hovers, sallies and pounces under the canopy, primarily over leaf litter and dead timber. Occasionally forage for nectar, fruit and seed. The REF proposal is likely to impact upon 1.17 ha of potential foraging habitat for this species within the study area. This habitat extends to areas of habitat that occur to the south and south west of the study area. Due to the small area of foraging habitat which will be impacted, the REF proposal is considered unlikely 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.

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

- **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**
- **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

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

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

The proposed development will involve the removal or modification of 1.17 ha of potential foraging habitat for the species.

- **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**

The REF proposal will involve the loss of 1.17 ha of species habitat in the study area. The proposed clearing is a linear strip of habitat occurring on the edge of the existing highway. These areas are already subject to edge effects and weeds and pests and clearing would not result in increases in fragmentation. The REF proposal would however result in an increase in some isolation of remaining habitat as the current habitat patches would be made smaller which would result in a minor increase in the physical distance between habitat fragments. Additionally, although the action would shift the edge effects to adjacent areas, mitigation measures would be implemented to minimise weed spread, sedimentation/runoff and other impacts to adjacent areas. The REF proposal is considered likely unlikely to result in existing fragmentation or prevent movements to and from an abundance of similar and higher quality habitat within the wider locality.

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

The habitat removed includes dry open forest which is part of a larger extent of foraging habitat that occurs to the south and south west of the study area. Although the REF proposal will add incrementally to foraging habitat loss within the locality it is unlikely to exacerbate fragmentation at local or regional scales that would prevent these species from foraging or breeding within the locality. Given the small area to be impacted (1.17 ha), the mobile nature of these species, and the availability of suitable habitat in the wider locality, the loss of a very small amount of potential foraging habitat is unlikely to affect the long-term survival of this species.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

Of relevance to the Dusky Woodswallow, the proposed development will involve the KTPs of

- clearing of native vegetation
- removal of dead wood and dead trees.

Mitigation measures would be implemented for the proposal to address impacts to biodiversity including rehabilitation (i.e. revegetation re-use of nest hollows and coarse woody debris), prevention and management of weeds and pathogens, containment of sedimentation and runoff. KTPS will be limited through the implementation of mitigation measures.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the REF proposal, is very small (1.17 ha) in terms of the available habitat for this species within the surrounding landscape. The REF proposal is unlikely to have a significant impact upon the Dusky Woodswallow.

Eastern Osprey

Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes; and feed on fish over clear, open water.

Status

Eastern Osprey is listed as Vulnerable under the BC Act.

Specific impacts

Eastern Osprey is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. The species is considered to have a moderate likelihood of occurring within the study area due to the presence of potential foraging habitat along the Georges River in the west of the study area. The REF proposal would involve the clearing or disturbance of 1.27 ha of potential foraging habitat for the species within the study area.

The following assessment has been undertaken following the *Threatened Species Test of Significance Guidelines* (Office of Environment & Heritage, 2018). Under the Act 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:

Section 7.3 Test of Significance

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 REF proposal would impact upon 1.27 ha of potential foraging habitat for the species within the study area. The river extends considerably outside of the impact area and the associated habitat is common within the surrounding locality. Due to the relatively small area (1.27 ha) of foraging habitat which will be impacted, the REF proposal is not considered 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.

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

- **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**
- **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

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

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

The proposed development will involve the removal of 1.27 ha of potential foraging habitat for the species.

- **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**

The REF proposal will involve the removal or modification of 1.27 ha of species habitat in the study area along the Georges River. The proposed clearing is likely to impact a very small proportion of available foraging habitat for the species and clearing would not result in increasing fragmentation.

Additionally, specific mitigation measures would be implemented to minimise impacts to aquatic habitat within and adjacent to the study area, as well as general mitigation measures to minimise indirect impacts of weed spread, sedimentation/runoff. The REF proposal is considered unlikely to add substantially to existing fragmentation or prevent movements to and from an abundance of similar and higher quality habitat within the wider locality.

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

The habitat removed includes aquatic habitat along the Georges River. The river extends considerably outside of the impact area and the associated habitat is common within the surrounding locality. Although the REF proposal will add to a small extent to the foraging habitat loss within the locality it is unlikely to exacerbate fragmentation at local or regional scales that would prevent these species from foraging or breeding within the locality. Given the small area to be impacted (1.27 ha), the mobile nature of these species, and the availability of suitable habitat in the wider locality, the loss of a very small amount of potential foraging habitat is unlikely to affect the long-term survival of this species.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

Under the BC Act a Key Threatening Process (KTP) is ‘a process that threatens, or that may threaten, the survival or evolutionary development of species or ecological communities’. Currently 38 Key Threatening Processes (KTPs) are listed for NSW (Office of Environment & Heritage, 2018).

Of relevance to the Eastern Osprey, the proposed development will involve the KTP of “clearing of native vegetation” and has the potential to add to the threat “Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments”. Mitigation measures would be implemented for the REF proposal to address impacts to biodiversity including rehabilitation (i.e. revegetation), measures to protect aquatic habitat, management of hydrology, prevention and management of weeds and pathogens, containment of sedimentation and runoff. KTPs will be limited through the implementation of mitigation measures.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the REF proposal, is very small (1.27 ha) relative to the available habitat for this species within the surrounding landscape. The REF proposal is unlikely to have a significant impact upon the Eastern Osprey.

Little Lorikeet

Status

The Little Lorikeet (*Glossopsitta pusilla*) is listed as Vulnerable under the BC Act.

Specific Impacts

The REF proposal is likely to impact upon 1.17 ha of potential habitat for the Little Lorikeet. The REF proposal may also require the removal of 11 hollow-bearing trees which provide roosting and breeding habitat for this species.

Section 7.3 Test of Significance

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.

A total of 1.17 ha of habitat, representing potential foraging habitat for the Little Lorikeet. The Little Lorikeet could utilise hollow-bearing trees for breeding and roosting within the study area, 11 hollow-bearing trees are likely to be removed. 38 hollow-bearing trees are likely to be retained. Although the REF proposal may represent the loss of habitat, the loss of such resources within the study area is only a very small marginal component of locally occurring resources that are accessible to this species in the wider region. Therefore, the REF proposal is considered unlikely to impact this species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

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

- **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**
- **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.

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

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

The REF proposal will remove or alter approximately 1.17 ha of potential foraging habitat and 11 hollow-bearing trees which provide roosting and breeding habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion of habitat available within the surrounding landscape. The habitat to be removed is a linear strip along an existing highway, therefore the REF proposal is unlikely to result in fragmentation or isolation of existing habitats within the region.

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

The extent of potential habitat to be removed represents a very small proportion (1.69 ha) of habitat available within the surrounding landscape. The habitat to be removed is occurs as a linear strip of Milperra Road and Henry Lawson Drive and is already modified by existing edge effects and isolated from other areas of habitat. Therefore, the habitat for the Little Lorikeet is considered unlikely to be of high importance.

- **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 study area is not a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

With respect to the Little Lorikeet, the REF proposal is consistent with three Key Threatening Processes under the BC Act:

- clearing of native vegetation
- loss of hollow-bearing trees
- removal of dead wood and trees.

The extent of native vegetation clearing and habitat removal associated with the REF proposal is considered relatively small (1.17 ha and hollow-bearing trees) in terms of the available habitat for these species within the surrounding landscape, although it is considered to be an incremental loss of suitable habitat locally.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the REF proposal, is very small (1.17 ha) in terms of the available habitat for this species within the surrounding landscape. Although the loss of foraging habitat for the Little Lorikeet is considered to be an incremental loss of suitable habitat locally, the REF proposal is not likely to have a significant impact upon these species that might lead to their extinction locally

Swift Parrot

Status

The Swift Parrot (*Lathamus discolor*) is listed as Endangered under the BC Act and Critically Endangered under the EPBC Act.

The Swift Parrot is a migratory species, which only breeds in Tasmania, is only present on the mainland between April and September to seek nectar resources from winter flowering events.

Specific Impacts

The REF proposal will result in the disturbance 1.17 ha of foraging habitat, which may provide potential foraging habitats for these species.

Section 7.3 Test of Significance

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.

A total of 1.17 ha of habitat, representing potential foraging habitat for the Swift Parrot would be removed as a result of the REF proposal. Although the REF proposal may represent the loss of habitat, the loss of such resources within the study area is only a very small marginal component of locally occurring resources that are accessible to these species. Therefore, the REF proposal is considered unlikely to impact this species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

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

- **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**
- **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.

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

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

The REF proposal will remove or alter approximately 1.17 ha of potential foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion of habitat available within the surrounding landscape. The habitat to be removed is a linear strip along Milperra Road and Henry Lawson Drive, therefore the REF proposal is unlikely to result in fragmentation or isolation of existing habitats within the region.

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

The extent of potential habitat to be removed represents a very small proportion (1.17 ha) of habitat available within the surrounding landscape. The habitat to be removed is occurs as a linear strip of Milperra Road and Henry Lawson Drive and is already modified by existing edge effects and isolated from other areas of habitat. Therefore, the habitat for the Swift Parrot is considered unlikely to impact upon the long-term survival of this species.

- **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 study area is not a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

With respect to the Swift Parrot, the REF proposal is consistent with three Key Threatening Processes under the BC Act:

- clearing of native vegetation.

The extent of native vegetation clearing and habitat removal associated with the REF proposal is considered relatively small (1.17) in terms of the available habitat for this species within the surrounding landscape, although it is considered to be an incremental loss of suitable habitat locally.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the REF proposal, is very small (1.17 ha) in terms of the available habitat for this species within the surrounding landscape. Although the loss of foraging habitat for the Swift Parrot is considered to be an incremental loss of suitable habitat locally, the REF proposal is not likely to have a significant impact upon this species that might lead to its extinction.

EPBC Act Significance assessment – Swift Parrot

The Swift Parrot is listed as Critically Endangered under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of Environment 2013).

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will result in one or more of the following:

- **Lead to a long-term decrease in the size of a population of a species**

Approximately 1.17 ha of potential foraging habitat for the Swift Parrot would be affected by the REF proposal. While limited habitat in the study area has the potential to be used by these species, it is not likely to be of high importance due to its relatively small area and the availability of equal or greater quality habitat within the locality and wider region. Any identified population of Swift Parrot in the area would not be restricted to habitat within the study area. Due to the species' large home range and nomadic nature, similar foraging habitat can be accessed in the locality. Therefore, the REF proposal is not considered likely to significantly contribute to a long-term decline in the size of a population of these species.

Reduce the area of occupancy of the species

The REF proposal is likely to affect approximately 1.17 ha of potential foraging habitat for this species. Although the REF proposal will result in the loss of potential foraging habitat, the incremental loss of a small area of potential habitat, only represents a small component of similar locally occurring resources accessible for this species. Nevertheless, the removal of approximately 1.17 ha of potential habitat is considered to be a small incremental loss of suitable habitat locally and as such has the potential to incrementally reduce the area of occupancy for the Swift Parrot during seasons when individuals of this species may be reliant on local resources.

Fragment an existing population into two or more populations

Habitat connectivity is unlikely to be significantly exacerbated by the REF proposal other than what already exists in the area. The proposed habitat impacted upon is a linear strip occurring on the edge of the Milperra Road and Henry Lawson Drive. The REF proposal is would not significantly exacerbate fragmentation than what already exists. Furthermore, given that this species are highly mobile, the REF proposal would not present a significant barrier to these species.

Adversely affect habitat critical to the survival of a species

No critical habitat has been listed for the Swift Parrot to date. The study area does not contain any breeding areas nor is the study area the only limiting foraging area for these species, as such it is unlikely that this REF proposal will adversely affect habitat critical to the survival of these species.

Disrupt the breeding cycle of a population

Swift Parrots breed in Tasmania during spring and summer, migrating to south-eastern Australia during autumn and winter (Department of Environment and Conservation 2006). While Swift Parrots are dependent on flowering resources across a wide range of habitats (woodlands and forests) within their NSW wintering grounds, the removal of approximately 1.17 ha of potential foraging habitat is unlikely to disrupt their movements to Tasmanian breeding grounds. As such the REF proposal is unlikely to affect their breeding cycle.

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

The REF proposal would remove 1.17 ha of potential habitat for this species. The removal of approximately 1.17 ha of potential foraging habitat is considered to be an incremental loss of suitable habitat foraging habitat locally. However, the loss of a small potential foraging habitat for the Swift Parrot is unlikely to be at an extent in which this species is likely to decline.

Result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Swift Parrot would become further established as a result of the REF proposal.

Introduce disease that may cause the species to decline

No. It is unlikely that disease would be increased by the REF proposal.

Interfere with the recovery of the species

The Action Plan for Australian Birds (Garnett and Crowley 2000) notes pressure on Swift Parrot breeding areas from forestry and firewood collection in Tasmania. On the mainland though pressures relate to the loss of foraging habitats due to clearing for agriculture and residential development (Garnett and Crowley 2000).

A National Recovery Plan for the Swift Parrot *Lathamus discolor* was prepared in 2011 (Saunders 2011). Recovery actions outlined in this plan include:

- 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.

Based on the potential ecological impacts of the REF proposal on the Swift Parrot, as discussed above, it is likely the REF proposal would be in conflict with the second recovery action above, to manage and protect Swift Parrot habitat at the landscape scale.

Conclusion

The extent of native vegetation clearing and foraging habitat removal associated with the REF proposal is considered to be small relative to available habitat for the species within the region. Although it is considered unlikely that the loss of potential foraging habitat will cause the local extinction of the Swift Parrot, the REF proposal will remove habitat that may be utilised by this species under some intermittent seasonal contexts. The REF proposal is not considered to fragment any locally occurring populations, affect habitat critical to their survival, disrupt their breeding cycles, or interfere with the recovery of the species. The REF proposal therefore, is considered to represent an incremental loss of available local habitat, although it is not considered likely to have a significant impact on the Swift Parrot.

Varied Sittella

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.

Status

Varied Sittella is listed as Vulnerable under the BC Act.

Specific impacts

Varied Sittella is considered to have a moderate likelihood of occurring within the study area due to the presence of potential habitat (eucalypt forest) and has been recorded within the wider locality. The REF proposal would involve the clearing of disturbance of 1.17 ha of potential habitat for the species.

The following assessment has been undertaken following the *Threatened Species Test of Significance Guidelines* (Office of Environment & Heritage, 2018). Under the Act 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:

Section 7.3 Test of Significance

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.

Varied Sittella is sedentary and primarily inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Although the REF proposal may represent the loss of habitat, the loss of such resources within the study area is only a very small marginal component of locally occurring resources that are accessible for this species. The habitat to be removed is a linear strip that currently occurs on the edge of Henry Lawson Drive and Milperra Road. The REF proposal would involve the clearing of disturbance of 1.17 ha of potential habitat for the species within the study area. It is unlikely that the REF proposal will place a viable local population of this species at risk of extinction.

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

- **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**
- **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

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

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

The proposed development will involve the removal or modification of 1.17 ha of potential habitat for the species.

- **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**

The extent of potential habitat to be removed represents a very small proportion of habitat available within the surrounding landscape. The habitat to be removed is a linear strip along the edge of Henry Lawson Drive and Milperra Road, therefore the REF proposal is unlikely to result in fragmentation or isolation of existing habitats within the region

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

The extent of potential habitat to be removed represents a very small proportion (1.17 ha) of habitat available within the surrounding landscape. The habitat to be removed is along a linear strip along Henry Lawson Drive and Milperra Road and is already modified by existing edge effects and isolated from other areas of habitat. Therefore, the habitat for the Varied Sittella is considered unlikely to be of high importance.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

Of relevance to the Varied Sittella, the proposed development will involve the KTPs

- clearing of native vegetation
- removal of dead hollows and trees

Mitigation measures would be implemented for the REF proposal to address impacts to biodiversity including rehabilitation (i.e. revegetation re-use of nest hollows and coarse woody debris), prevention and management of weeds and pathogens, containment of sedimentation and runoff. KTPS will be limited through the implementation of mitigation measures.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the REF proposal, is very small (1.17 ha) in terms of the available habitat for this species within the surrounding landscape. The REF proposal is unlikely to have a significant impact upon the Varied Sittella.

White-bellied Sea Eagle

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. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. The White-bellied Sea-eagle occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. The White-bellied Sea-eagle feeds mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion.

Status

White-bellied Sea Eagle is listed as marine under EPBC Act and Vulnerable under the BC Act.

Specific impacts

White-bellied Sea Eagle was recorded off-site foraging along Georges River. No nesting or potential nesting trees were observed within the study area. The REF proposal would involve the clearing of disturbance of 1.27 ha of habitat for the species.

The following assessment has been undertaken following the *Threatened Species Test of Significance Guidelines* (Office of Environment & Heritage, 2018). Under the Act 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:

Section 7.3 Test of Significance

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.

Approximately 1.27 ha of potential habitat is likely to be affected by the REF proposal. Due to the mobility and large home range of these species, and the linear footprint of this REF proposal, the REF proposal is unlikely to affect their life cycle or ability to forage and breed. Local populations of the White-bellied Sea Eagle are unlikely to be restricted to habitat within the REF proposal area, as similar and higher quality habitat occurs widely in the locality. The impact of 1.27 ha of potential habitat would represent <1% of habitat in the greater locality and the study area would only represent a small part of the home ranges of locally occurring individuals.

Although the REF proposal will result in the loss of potential foraging habitat, such habitat would only be a small component of locally occurring resources accessible to these species, and it is unlikely to constitute important habitat that would place the White-bellied Sea-eagle at a greater risk of extinction.

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

- **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**
- **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

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

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

The proposed development will involve the removal or modification of 1.27 ha of habitat for the species.

- **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**

The REF proposal will involve the removal or modification of 1.27 ha of species habitat in the study area along the Georges River. Habitat connectivity is unlikely to be affected by the REF proposal due to the mobility of this species. Vegetation removal will largely be limited to a linear corridor along the edge of Henry Lawson Drive and Milperra Road. As the REF proposal area is largely confined to an area which is already impacted by edge effects, the REF proposal would not adversely fragment or isolate any previously undisturbed patches of habitat. Furthermore, given these species' high mobility and that habitat of similar and higher quality occurs widely in the locality, it is considered unlikely that habitat would become further isolated or significantly fragmented beyond that currently existing in the study area.

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

A total of 1.27 ha of potential foraging habitat for this species will be affected by the REF proposal. Owing to the relatively small proportion of potential foraging habitat impacted and the vast abundance of habitat in the locality, the REF proposal is unlikely to significantly affect the long-term survival of this species, although the loss of native vegetation habitat must be considered to be an incremental loss of local habitat.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

With respect to the White-bellied Sea-eagle, the REF proposal is consistent with one Key Threatening Process being clearing of native vegetation. The extent of native vegetation clearing and habitat removal associated with the REF proposal is considered relatively small in terms of the available habitat for this species within the surrounding landscape.

Conclusion

Approximately 1.27 ha of potential habitat will be impacted by the REF proposal. Owing to the abundance of land in the locality and the existing disturbances of this habitat (fragmentation) the loss of this foraging habitat is unlikely to adversely affect these species. Although the loss of habitat will represent an incremental loss of potentially suitable habitat, the REF proposal is unlikely to have a significant impact upon these species and their local populations.

White-Throated Needletail

The White-throated Needletail is listed as Vulnerable under the EPBC Act.

The White-throated Needletail is a migratory species and occurs in Australia only between late spring and early autumn but mostly in summer. This species are non-breeding migrants with breeding taking place in Northern Asia (BirdLife Australia, 2020). The White-throated Needletail feeds on flying insects, such as termites, ants, beetles and flies. They catch the insects in flight in their wide gaping beaks. They have been recorded roosting in trees in forests and woodlands, both among dense foliage in the canopy or in hollows. Probably recorded most often above wooded areas, including open forest and rainforest (BirdLife Australia, 2020). This species is not or near the limit of its range as it occurs over eastern and northern Australia and in Northern Asia (BirdLife Australia, 2020).

Specific impacts

The REF proposal has the potential to impact upon 1.17 ha of potential foraging habitat within the REF proposal area. However, the White-throated Needletail mainly feeds on flying insects.

EPBC Significance Assessment

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

This species is not or near the limit of its range as it occurs over eastern and northern Australia and in Northern Asia (BirdLife Australia, 2020). The study area only provides aerial foraging habitat with no breeding occurring within Australia or roosting habitat present. Therefore, a population of White-throated Needletail in the study area is not considered to be important.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

- **Lead to a long-term decrease in the size of an important population of a species**

Not applicable. White-throated Needletail occurring in the in the study area is not part of an important population.

- **Reduce the area of occupancy of an important population**

Not applicable. White-throated Needletail occurring in the in the study area is not part of an important population.

- **Fragment an existing important population into two or more populations**

Not applicable. White-throated Needletail occurring in the in the study area is not part of an important population.

- **Adversely affect habitat critical to the survival of a species**

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)

- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The REF proposal will remove a small area (1.17 ha) of a linear strip of native vegetation along the edge of Henry Lawson Drive and Milperra Road. The White-throated Needletail is a migratory species and breeds in northern Asia. This species forages on the wing and the vegetation within the study area is likely to provide aerial foraging habitat for this species. This species occurs widely along the coast of NSW and QLD whilst in Australia suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, this would not meet the above criteria and the study area is not critical to the survival of the White-throated Needletail.

- **Disrupt the breeding cycle of an important population**

Not applicable. White-throated Needletail does not breed within Australia and therefore is not part of an important population.

- **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The REF proposal will involve the removal or modification of 1.17 ha of species habitat in the study area along the Georges River. Habitat connectivity is unlikely to be affected by the REF proposal due to the mobility of this species. Vegetation removal will largely be limited to a linear corridor along Milperra Road. As the REF proposal area is largely confined to an area which is already impacted by edge effects, the REF proposal would not adversely fragment or isolate any previously undisturbed patches of habitat. Furthermore, given these species' high mobility and that habitat of similar and higher quality occurs widely in the locality, it is considered unlikely that habitat would become further isolated or significantly fragmented beyond that currently existing in the REF proposal area.

- **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

It is not likely that invasive species (such as introduced predators) that are harmful to the White-throated Needletail would become further established as a result of the REF proposal.

- **Introduce disease that may cause the species to decline**

No. There are no known diseases that are likely to increase in the area as a result of the REF proposal.

- **Interfere substantially with the recovery of the species**

As this species does not breed in Australia and forages on the wing and occurs has the potential to occur intermittently within the study area, the REF proposal is not likely to interfere with the recovery of this species.

Conclusion

The study area only provides aerial foraging habitat with no breeding occurring within Australia or roosting habitat present. The White-throated Needletail is likely to use the study area for aerial foraging on an intermittent basis and the REF proposal is not likely to have a significant impact upon available resources for this species in the vicinity of the study area or its wider locality. Therefore, the habitat to be impacted is not considered important to the long-term survival of the White-throated Needletail.

Cave-dwelling Micro bats

The following cave-dwelling micro bats have foraging potential within the study area, and potential artificial roosting habitat within the study area:

- Little Bent-wing Bat (*Miniopterus australis*), listed as Vulnerable on the BC Act
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*), listed as Vulnerable on the BC Act
- Southern Myotis – (*Myotis macropus*), Listed as vulnerable on the BC Act.

Specific Impacts

The Southern Myotis was recorded roosting within a culvert in the northern section of the study area. This culvert will be retained as part of the REF proposal. The Southern Myotis is a specialist waterways and riparian feeder and no areas of waterways are likely to be impacted as part of the REF proposal. The REF proposal may impact upon 1.27 ha of potential foraging habitat for the Southern Myotis. For the Little Bent-wing Bat and the Large Bent-winged Bat, the REF proposal has the potential to impacted upon 1.69 ha of foraging habitat.

Section 7.3 Test of Significance

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 Southern Myotis was recorded roosting in a road culvert under Henry Lawson Drive in the north of the study area. The Southern Myotis is a specialist waterways and riparian feeder.

There are foraging opportunities for these species associated with remnant vegetation, throughout the study area and in the wider locality. Approximately 1.69 ha of foraging habitat, 1.27 ha for Southern Myotis, would be affected by the REF proposal. These species often prefer to forage along the ecotonal edges between open and habitats and these types of foraging opportunities will continue to exist throughout the study area and further abroad. An abundance of available foraging habitat occurs within the locality (National Parks and reserves). The impact of 1.69 ha (1.27 for Southern Myotis) would represent a loss of <1% of potential habitat for these species. Therefore, the REF proposal is unlikely to cause significantly adverse effects upon cave-dwelling micro bat species, due to the relatively small proportion of available habitat removed and the retention of the culvert containing the recorded population of the Southern Myotis.

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

- **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**
- **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.

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

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

Approximately 1.69 ha of foraging habitat, comprising 1.27 ha for Southern Myotis, is likely to be affected by the REF proposal. No significant roosting habitat will be impacted.

- **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**

The REF proposal would likely impact foraging habitat which occurs in linear strips adjacent to Milperra Road and Henry Lawson Drive.

As the REF proposal will result in widening of existing linear vegetation corridors in association with Milperra Road, and Henry Lawson Drive and given these species high mobility, the REF proposal is unlikely to significant increase habitat isolation and or fragmentation.

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

The REF proposal area provides a relatively small amount of potential foraging habitat for these species. The removal of 1.69 ha, comprising 1.27 ha for Southern Myotis, of potential foraging habitat will present <1% of available habitat for these species. Foraging opportunities occurring within the REF proposal area, such as ecotonal zones, will continue to exist and an abundance of similar and potential higher quality foraging opportunities will remain available the wider locality. The REF proposal would not impact habitat considered critical to the long-term survival of populations in the locality.

- **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 study area does not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

With respect to cave-dwelling micro bats, the REF proposal is consistent with one Key Threatening Process under the BC Act, being clearing of native vegetation.

The removal of potential foraging habitat associated with the REF proposal (1.27 ha for Southern Myotis and 1.69 ha for all other species) is considered to represent a small proportion of available higher quality habitat in the locality and adjoining the REF proposal area. Although the REF proposal will represent a small loss of potential foraging habitat, such habitat only represents a very small component of locally occurring resources accessible to these species.

Conclusion

The REF proposal will impact approximately 1.27 ha for Southern Myotis and 1.69 ha for all other species, representing a very small amount of potential foraging habitat for these species. Whilst potential habitat exists within the REF proposal area, the extent of habitat removal associated with the REF proposal is considered relatively small in terms of available local habitat for these species. Although the loss of habitat will represent a small incremental loss of cave-dwelling micro bat habitat, the REF proposal is unlikely to have a significant impact upon these species. The culvert in which a single individual of Southern Myotis was recorded will be retained as part of the REF proposal.

Hollow-dwelling Micro bats

Status

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), listed as Vulnerable on the BC Act

Eastern Freetail-bat (*Micronomus norfolkensis*), listed as Vulnerable on the BC Act

Greater Broad-nosed Bat (*Scoteanax rueppellii*) is listed as Vulnerable under the BC Act.

Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) is listed as Vulnerable under the BC Act.

Specific Impacts

The REF proposal would remove approximately 1.69 ha of potential habitat, in the form of all native vegetation communities with foliage foraging opportunities. In addition to vegetation to be cleared, 11 hollow-bearing trees would be impacted by the REF proposal. Habitat to be impacted provides foraging, roosting and breeding resources for these species.

Section 7.3 Test of Significance

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 study area contains native vegetation communities that occur as a narrow linear corridor along the Henry Lawson Drive and Milperra Road. Approximately 1.69 ha of potential foraging habitat would be impacted. This habitat provides foraging and roosting for hollow dependant micro bats. In addition, 11 hollow-bearing trees will be removed as part of the REF proposal with detailed design to avoid further impacts where possible.

While the habitat to be removed represents foraging and breeding opportunities for hollow-dwelling micro bats, it is considered unlikely that the removal of this habitat will significantly affect locally occurring micro bat populations, due to quality of the habitat to be impacted (roadside vegetation).

The REF proposal is unlikely to have an adverse effect on the life cycle of hollow-dwelling micro bats to the point where these species are likely to be placed at risk of extinction.

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

- **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**
- **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.

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

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

Approximately 1.69 ha of potential foraging habitat and 11 hollow-bearing trees would be impacted upon by the REF proposal.

- **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**

Habitat connectivity is not likely to be affected by the REF proposal. The majority of the study area occurs on previously disturbed land associated with existing road corridor. The vegetation that is likely to be affected will be largely limited to previously disturbed areas adjacent to the existing roadside. Consequently, it is considered unlikely that the REF proposal would significantly isolate or fragment potential habitat beyond which currently exists within the study area. As the REF

proposal will result in disturbance to linear corridors through disturbed habitat, and given the species high mobility, the REF proposal is unlikely to represent significant increases to habitat isolation and or fragmentation.

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

Although the REF proposal will add incrementally to foraging habitat loss within the locality it is unlikely to exacerbate fragmentation at local or regional scales that would prevent these species from foraging or breeding within the locality. Given the small area to be impacted (1.69 ha), the mobile nature of these species, and the availability of suitable habitat in the wider locality, the loss of a very small amount of potential foraging habitat is unlikely to affect the long-term survival of these species.

- **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 study area does not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

With respect to cave-dwelling micro bats, the REF proposal is consistent with three KTPs being:

- clearing of native vegetation
- loss of hollow-bearing trees
- removal of dead wood and trees.

The REF proposal would likely remove a small area (1.69) of potential foraging habitat associated with and 11 hollow-bearing trees which provides roosting and breeding habitat for these species.

Although the impact as a result of the REF proposal would represent a small loss of potential foraging habitat, roosting and breeding habitat, such habitat represents a very small component of locally occurring resources accessible to these species. Mitigation measures would be implemented as part of the REF proposal to address impacts to biodiversity including rehabilitation (i.e. revegetation re-use of nest hollows and coarse woody debris), prevention and management of weeds and pathogens, containment of sedimentation and runoff. KTPS will be limited through the implementation of mitigation measures. In addition, a microbat management plan would likely be implemented if micro-bats are found during pre-clearing surveys (prior to construction) to address mitigation measures for the loss of habitat for these species.

Conclusion

The REF proposal will impact approximately 1.69 ha, representing a very small amount of potential foraging habitat for these species. Eleven hollow-bearing trees are likely to be impact upon by the REF proposal. Whilst potential foraging, breeding and roosting habitat exists within the REF proposal area, the extent of habitat removal associated with the REF proposal is considered relatively small in terms of available local habitat for these species. Although the loss of habitat will represent a small incremental loss of hollow dependant micro bat habitat, the REF proposal is unlikely to have a significant impact upon these species.

Grey-headed flying-fox

Status

The Grey-headed Flying-fox (*Pteropus poliocephalus*) listed as Vulnerable under both the BC Act and EPBC Act. This species was recorded during the survey. The Grey-headed Flying-fox has been assessed due to the species widespread occurrence locally, its high mobility and the occurrence of native tree species that are known to be used by this species for the purpose of foraging.

Specific Impacts

The REF proposal has the potential to remove 1.17 ha of potential foraging habitat for the Grey-Headed Flying-fox.

Section 7.3 Test of Significance

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.

A total of 1.17 ha of foraging habitat for the Grey-headed Flying-fox, may be affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat, such resources within the study area is only a very small component of locally occurring resources that are accessible to this species. No breeding camps are present within the study area. Therefore, the proposed works are considered unlikely to impact this species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

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

- **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**
- **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.

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

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

The REF proposal will remove approximately 1.17 ha foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (1.17 ha) of foraging habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat removal and the mobility of these species, the REF proposal is unlikely to significantly affect their long-term survival.

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

The extent of potential habitat to be removed represents a small (1.17 ha) proportion of habitat available within the surrounding landscape. Owing to the relatively small extent of habitat removal and the mobility of the species, the REF proposal is unlikely to affect the long-term survival of the Grey-headed Flying-fox.

- **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 study area is not a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

- **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.**

With respect to the Grey-headed Flying-fox, the REF proposal is consistent with one Key Threatening Process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal, associated with the proposed works is considered very small (1.17 ha) in terms of available habitat for this species within the surrounding landscape.

Conclusion

The extent of native vegetation clearing and habitat removal associated with the REF proposal is very small (1.17 ha) in terms of the available habitat for this species within the surrounding landscape. Furthermore, no breeding camps are located within the study area. The potential loss of foraging habitat for the Grey-headed Flying-fox is not considered to be important in regard to the maintenance of this species locally, and therefore the REF proposal is unlikely to have a significant impact upon this species, which might lead to its extinction locally.

EPBC Significance Assessment – Grey-headed Flying-fox

The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Grey-headed Flying-foxes occur across a range of habitats where their favoured food, eucalypt blossom occurs. They set up roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, the habitat within the REF proposal area is considered as 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 result in one or more of the following:

- **Lead to a long-term decrease in the size of an important population of a species**

Not applicable. Grey-headed Flying-fox occurring in the in the study area is not part of an important population.

- **Reduce the area of occupancy of an important population**

A minor area of habitat being, 1.17 ha and as such is unlikely to lead to a long-term decrease in size in the Grey-headed Flying-Fox populations.

- **Fragment an existing important population into two or more populations**

No Grey-headed Flying-fox camps occur within the REF proposal and the habitat to be impacted upon is minor. Therefore, the REF proposal is unlikely to fragment the population into two or more populations.

- **Adversely affect habitat critical to the survival of a species**

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The REF proposal will remove a small area (1.17 ha) of potential foraging habitat for this species. As this species is highly mobile, with individuals foraging up to 50 km from roost sites, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, this would not meet the above criteria.

- **Disrupt the breeding cycle of an important population**

No Grey headed Flying-fox camps occur within the REF proposal area and the habitat to be impacted upon is minor. Therefore, the REF proposal is unlikely to disrupt the breeding cycle of the Grey-headed Flying-fox.

- **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The REF proposal is likely to involve subsurface construction work due to the installation of drainage infrastructure. These excavations could mobilise potential contaminants that may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the REF proposal. Whilst the REF proposal may increase water surface drainage and has the potential to mobilise contaminants to the Grey-headed Fly-fox foraging habitat within the REF proposal area, these would be reduced and managed through recommended mitigation measures. These impacts are unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the REF proposal.

- **Introduce disease that may cause the species to decline**

No. There are no known diseases that are likely to increase in the area as a result of the proposed works.

- **Interfere substantially with the recovery of the species**

Due to the limited foraging habitat likely to be affected by the proposed works (1.17 ha) and as no roost camps are located in the vicinity of the study area, the proposed works are not likely to interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing and habitat removal associated with the REF proposal is small (1.17 ha) in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Grey-headed Flying-fox is considered to be an incremental loss of suitable habitat locally, the REF proposal is not likely to have a significant impact upon Grey-headed Flying-fox.

Appendix D – Credit report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00024697/BAAS17020/21/00024717	Henry Lawson Drive Stage 1A - BAR	29/03/2021
Assessor Name	Report Created	BAM Data version *
Alexander Cockerill	26/05/2021	38
Assessor Number	BAM Case Status	Date Finalised
BAAS17020	Open	To be finalised
Assessment Revision	Assessment Type	
1	Part 5 Activities	

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

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

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
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Castlereagh Ironbark forest											
1	725_VZ1_M	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	64.7	64.7	0.21	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00	TRUE	7
Subtotal										7	
Coastal freshwater wetland											
2	781_VZ2_M	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	18.9	18.9	0.07	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00		1
Subtotal										1	
Cumberland riverflat forest											
3	835_VZ3_M	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	42.2	42.2	0.76	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00		16

4	835_VZ4_Moderate	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	43.5	43.5	0.19	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00	4
									Subtotal	20
Estuarine Swamp Oak forest										
5	1234_VZ12_Moderate	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	49.4	49.4	0.1	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00	2
									Subtotal	2
									Total	30

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAll	Species credits	
Callistemon linearifolius / Netted Bottle Brush (Flora)									
725_VZ1_Moderate	N/A	N/A	28	Vulnerable	Not Listed	1.5	False	42	
								Subtotal	42

<i>Myotis macropus / Southern Myotis (Fauna)</i>									
725_VZ1_Moderate	64.7	64.7	0.21	Vulnerable	Not Listed		2	False	7
781_VZ2_Moderate	18.9	18.9	0.07	Vulnerable	Not Listed		2	False	1
835_VZ3_Moderate	42.2	42.2	0.76	Vulnerable	Not Listed		2	False	16
835_VZ4_Moderate	43.5	43.5	0.19	Vulnerable	Not Listed		2	False	4
1234_VZ12_Moderate	49.4	49.4	0.1	Vulnerable	Not Listed		2	False	2
								Subtotal	30



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