



Richmond Road Upgrade

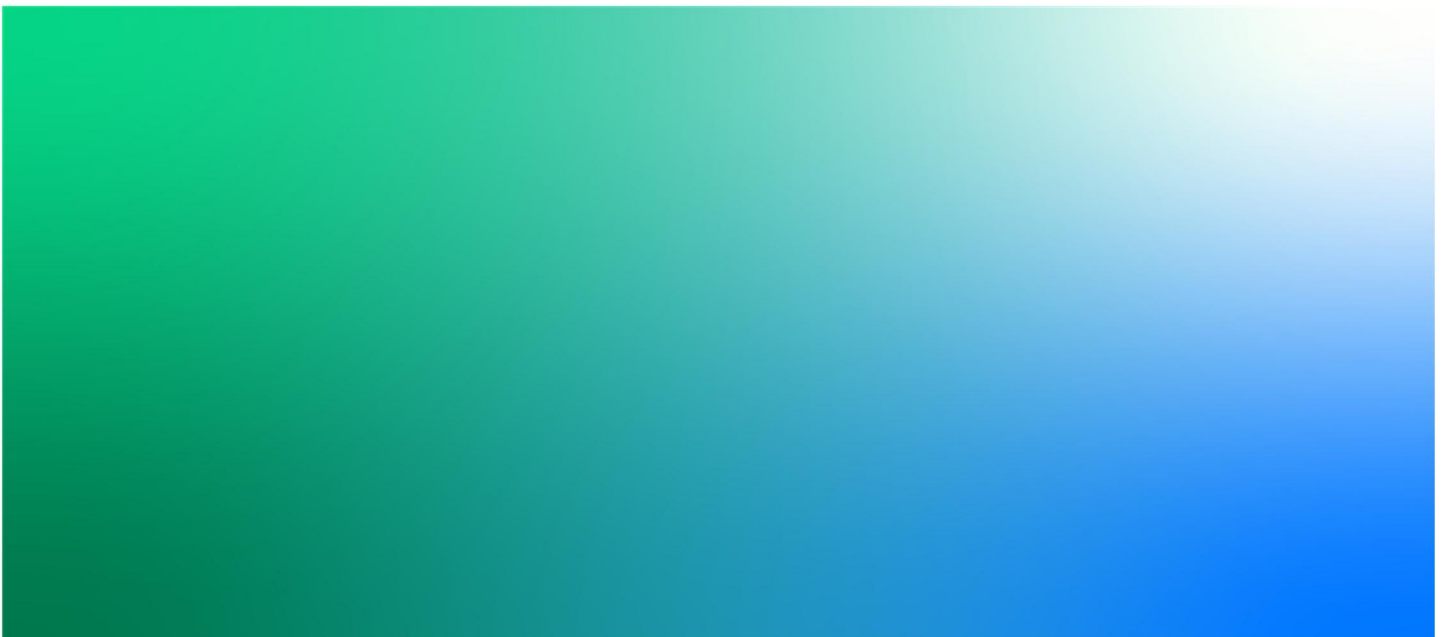
Marsden Park

Biodiversity Assessment

Final Report

12 October 2020

Transport for NSW



Richmond Road Upgrade, Marsden Park

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Jacobs Group (Australia) Pty Limited
 ABN 37 001 024 095
 Level 7, 177 Pacific Highway
 North Sydney NSW 2060 Australia
 PO Box 632 North Sydney
 NSW 2059 Australia
 T +61 2 9928 2100
 F +61 2 9928 2444
www.jacobs.com

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Final Report	12/10/20	Final Report v.D	Tim Maher	C.Thomson	C.Thomson	S.Riley-Lewis

Executive Summary

Transport for NSW propose to upgrade about 1.6 kilometres of Richmond Road north of Elara Boulevard in Marsden Park (the proposal). This report details the methods and results of a biodiversity survey and assessment of the distribution and abundance of threatened species, populations and ecological communities, and the extent and magnitude of ecological impacts associated with the proposal.

Part of the study area for the Richmond Road upgrade proposal is located within lands subject to the Sydney Region Growth Centre, and subject to the provisions of State Environmental Planning Policy (Sydney Region Growth Centres) 2006. Further to this, part of the study area falls within biodiversity 'certified' land pursuant to Section 8.2 of the *Biodiversity Conservation Act 2016* (BC Act).

Section 8.4(4) BC Act provides that "An activity to which part 5 of the EP&A Act applies which is carried out or proposed to be carried out on biodiversity certified land is taken, for the purposes of part 5 of the EP&A Act, to be an activity that is not likely to significantly affect any threatened species, population or ecological community, or its habitat under this Act:

A determining authority under Part 5 of the EP&A Act is not required under that Part to consider the effect on biodiversity of an activity carried out on biodiversity certified land (section 8.4(5) BC Act).

An ecological survey was undertaken within the study area on the 26 March and 4 June 2020. The survey aimed to ground-truth the results of the background research and desktop habitat assessment. All threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field surveys and habitat assessment. Vegetation surveys were completed in line with the Biodiversity Assessment Method (BAM). Targeted surveys were completed for threatened flora species and the Cumberland Plain Land Snail. The habitat value of the creek mapped across the proposal was characterised in accordance with NSW Department of Primary Industries (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)*.

The study area consists of about 22.2 hectares of land certified by the Western Sydney Growth Centres Order 2007 under the then TSC Act associated with the Marsden Park urban development precinct under SEPP (Sydney Growth Centres) 2006. About 0.83 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered ecological community (CEEC) under the BC Act located within biocertified land will be affected by the proposal. Clearing of listed CEEC or species within the certified land does not need further biodiversity assessment under BC Act.

Furthermore, the Commonwealth Environment Minister has approved all actions associated with the development of the Western Sydney Growth Centres as described in the Sydney Growth Centres Commonwealth Strategic Assessment: Program report. Therefore, being within the approved North West Growth Centre, this proposal does not require tests of significance for Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The remainder of vegetated areas are classed as highly disturbed areas – cleared paddocks, road verges, table drains, road embankments, ploughed paddocks etc. (this includes the proposed compound sites and off-site flood storage area).

No threatened ecological communities (TECs) listed under the BC or EPBC Acts were identified in the non-certified area of the study area.

One threatened flora species under BC Act was recorded in the study area during the field survey undertaken for the proposal Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*). This included twenty specimens on

non-certified land near the property boundary of DP715318 north of Richmond Rd and 500+ on certified land also near the property boundary of DP715318 north of Richmond Rd. Impacts on specimens found on certified land were not assessed in this REF. The impact of clearing about 0.01 hectares of the threatened Juniper-leaved Grevillea on non-certified land is assessed as being not significant.

The following species listed under the BC and/or EPBC Acts are either known to occur in adjacent habitat or are considered at likely to occur, on non-certified land, in the study area based on the presence of suitable habitat:

- § Cumberland Plain Land Snail (*Meridolum corneovirens*)
- § Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- § Little Lorikeet (*Glossopsitta pusilla*)
- § Swift Parrot (*Lathamus discolor*)
- § Little Bent-wing Bat (*Miniopterus australis*)
- § Large Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- § Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- § Eastern Freetail-bat (*Mormopterus norfolkensis*)
- § Southern Myotis (*Myotis macropus*)
- § Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- § Large-eared Pied Bat (*Chalinolobus dwyeri*)
- § Grey-headed Flying-fox (*Pteropus poliocephalus*)

The key impacts of the proposal include the removal of:

about 0.83 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered ecological community (CEEC) under the BC Act within certified land

about 500 specimens of threatened Juniper-leaved Grevillea on certified land

about 0.27 hectares of mature, native tree species on certified land

0.14 hectares of mix of mature, native tree species native vegetation within non-certified land comprising potential foraging habitat for listed threatened species

about 20 specimens (i.e. 0.01 hectares) of threatened Juniper-leaved Grevillea within non-certified land.

about 1.38 hectares of highly disturbed exotic vegetation within non-certified land

No vegetation mapped as Existing Native Vegetation in the SEPP Growth Centres will be impacted by the proposal.

Fauna injury or death has the greatest potential to occur during vegetation clearing, and the extent of this impact would be proportionate to the extent of vegetation that is cleared. Indirect / operational impacts including a minor increase in habitat isolation. Invasion and spread of weeds, invasion and spread of pests, and invasion and spread of pathogens and disease are a risk with a proposal of this type. Noise, light and vibration would be increased during construction and operation. Significant impacts to aquatic ecosystems are unlikely to occur as a result of the proposal.

The study area is situated in a cleared landscape due to historic activities. In the context of historic vegetation removal, any future vegetation clearing no matter how small would result in incremental cumulative impact that

would detrimentally affect biodiversity. The proposal would contribute to cumulative biodiversity impacts, by a small, not significant amount.

Mitigation measures described in Section 5 would be implemented during the construction and operational phases to lessen the potential ecological impacts of the proposal. Transport for NSW *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011a) identify a range of mitigation techniques to be applied and these techniques must be implemented during construction. Due to the presence of threatened *Grevillea juniperina* subsp. *juniperina* plants and a critically endangered ecological community, exclusion zones would be established to delineate the works limit boundary to ensure no accidental impacts occur.

Since the 0.01 hectares clearing of the BC Act listed *Grevillea juniperina* subsp. *juniperina* will not exceed 5 hectares (within non-certified land), the environmental offsets policy, under the Transport for NSW *Guideline for Biodiversity Offsets* (Roads and Maritime Services, 2016) does not apply. Despite this, there will be a larger impact to this species within the certified land, that is already approved to be cleared pursuant to the order certifying land within the Growth Centres SEPP. Given the likelihood of a cumulative impact on this species, a mitigation strategy is considered appropriate, and should include avoidance of plants where possible, seed collection, propagation and replanting.

In the context of the proposed development and considering only impacts to non-certified land under the Growth Centres SEPP, the biodiversity assessment concludes that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act.

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1. Introduction

1.1 Proposal background

Richmond Road is one of the main north-south arterial roads for Sydney's north west, providing a vital link for freight and commuters between Blacktown and Windsor. Richmond Road forms part of the wider arterial network, from the M7 Motorway to new housing and employment precincts in the north west priority growth area. The location of the proposal is shown in [Figure 1-1](#).

Richmond Road has a strategic function as a movement corridor that provides connectivity between residential, commercial and social land uses. It forms part of the wider arterial network, from the M7 Motorway to new housing and employment areas in the North West Growth Area. Traffic generated from residential, industrial and commercial land uses including several housing developments, a neighbourhood shopping centre, Marsden Park town centre and Marsden Business Park, results in Richmond Road accommodating a range of trip types. It has been predicted that over the next 10 years, about 33,000 homes would be constructed in the development area.

Richmond Road is also a regional flood evacuation route for Bligh Park and Windsor Downs, located about three and 4.7 kilometres north of the proposal respectively. Infrastructure NSW (INSW) and State Emergency Services (SES) identified that raising Richmond Road was required to relieve the high demand on the south western boundary to improve flood evacuation routes for the Hawkesbury-Nepean Valley.

1.2 The proposal

Transport for NSW propose to upgrade about 1.6 kilometres of Richmond Road north of Elara Boulevard in Marsden Park (the proposal). The proposal is located in the Blacktown Local Government Area (LGA) (refer Figure 1-1).

Key features of the proposal would include:

- § A dual carriageway with two lanes in each direction and a central median wide enough to accommodate six lanes in the future.
- § Raising the road by about five metres as the first stage of improving the road as a flood evacuation route.
- § Provision of two-metre-wide shoulders on both sides of the road.
- § Provision of a separate left-in and left-out access roads to Marsden Park Precinct (MPP) to the west.
- § Provision of a new four-way signalised intersection about 800 metres north of Elara Boulevard, to provide access to Marsden Park Precinct to the west and Marsden Park North Precinct to the east (MPNP).
- § Provision of bus bays and bus priority measures at the new four-way signalised intersection.
- § Provision of a three-metre-wide shared user path on the western side of the road.
- § Relocation and/or adjustments of public utilities and street lighting.
- § Road drainage infrastructure including a new culvert.
- § Ancillary work including safety barriers, signage, line marking and environmental protection work.
- § Landscaping and rehabilitation work.
- § Offsite compensatory flood storage area.
- § Temporary ancillary facilities include site compounds and stockpile sites.

1.3 Objectives of the biodiversity assessment

This biodiversity assessment supports the Review of Environmental factors (REF). This report aims to assess the extent and magnitude of biodiversity impacts associated with the proposal. The report presents details of the methods and results of a field survey and desktop assessment to identify the presence of threatened species, populations and ecological communities and their habitats. This report addresses the requirements for assessment of significance under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Mitigation measures to ameliorate biodiversity impacts arising from the proposal are also provided.

The specific aims of the biodiversity assessment are to:

- § Describe the characteristics and ecological condition of the vegetation communities and habitats within the study area.
- § Determine the occurrence, or likelihood of occurrence of threatened species, populations and communities listed under the *Biodiversity Conservation Act 2016* (BC Act) and EPBC Act within the study area.
- § Describe the potential impacts on biodiversity in the study area.
- § Undertake a test of significance for threatened species and communities that are confirmed or considered likely to occur within the study area in accordance with section 7.3 of the BC Act to determine whether the proposal is likely to significantly affect threatened species.
- § Undertake assessments in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of Environment, 2013) to consider impacts to nationally listed threatened species, ecological communities and migratory species
- § Propose measures to mitigate impacts on ecological values

1.4 Legislative context

A Review of Environmental Factors (REF) has been prepared to fulfil Transport for NSW's obligations under s.111 of the 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.112 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF prepared for the Richmond Road, Marsden Park Upgrade and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Under s.111 of the EP&A Act, Transport for NSW must consider the effect of an activity on:

- § any conservation agreement entered into under the *National Parks and Wildlife Act 1974* (NP&W Act)
- § any plan of management adopted under the NP&W Act for the conservation area to which the agreement relates,
- § any joint management agreement entered into under the http://www.austlii.edu.au/au/legis/nsw/consol_act/tsca1995323/ BC Act
- § any Biodiversity Stewardship Agreement entered into under the BC Act
- § any wilderness area (within the meaning of the *Wilderness Act 1987*) in the locality
- § critical habitat
- § threatened species, populations and ecological communities, and their habitats and whether there is likely to be a significant effect
- § any other protected fauna or protected native plants within the meaning of the BC Act.

Section 5A of the EP&A Act require that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act is assessed using the test of significance. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General's requirements. The test of significance refers to section 7 of the BC Act.

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Transport for NSW activities being assessed under Part 5 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 a 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 for NSW 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* (DoE 2013).

Part of the study area is located with the Sydney Region Growth Centre, details regarding the relevance of the State Environmental Planning Policy (Sydney Region Growth Centres) to this project is described below.

1.4.1 Biodiversity Certification of the State Environmental Planning Policy (Sydney Region Growth Centres) 2006

The Growth Centres SEPP established the broad framework for development of the Growth Centres over the next 25 to 30 years. An order conferring Biodiversity Certification on the Growth Centres SEPP was made by the Minister for the Environment under section 126G of the then TSC Act.

The Biodiversity Certification Order provides that any developments or activities proposed to be undertaken within certified areas do not need to undertake assessment of impacts on threatened species, populations and ecological communities, or their habitats, that would normally be required by Parts 3, 4 or 5 of the EP&A Act. Development within non-certified land within the Growth Centres requires assessment under normal legislative requirements.

The study area falls within Biodiversity certified and non-certified lands (see [Figure 1-2.1](#) and [Figure 1-2.2](#)). Parts of the investigation area north of South Creek and some sections north of Richmond Road are not certified. Elements of the study area that fall outside of the Biodiversity certified area require assessment of significance under NSW and Commonwealth impact assessment legislation.

1.4.2 Commonwealth Strategic Assessment of the Sydney Growth Centres

The Department of Planning, Industry and Environment (DPIE) in consultation with the then Department of Environment and Energy (DoEE) (DoP, 2010), undertook a Commonwealth Strategic Assessment under the EPBC Act of the Sydney Growth Centres Program (the Program). On 20 December 2011, the Commonwealth Environment Minister endorsed the Program. On 28 February 2012, the Minister approved all actions associated with the development of the Western Sydney Growth Centres as described in the Sydney Growth Centres Commonwealth Strategic Assessment: Program report.

Approval of the program means that individual projects associated with the development of the Sydney growth centres, as described in the Sydney Growth Centres Strategic Assessment Program Report, do not need any further approval under the EPBC Act.

Therefore, this Proposal within the approved North West Growth Centre does not require tests of significance for MNES under the EPBC Act. However, the normal assessment applies to Matters of NES on land that is non-certified.

An assessment of significance has been conducted for MNES that have been positively identified or that have a moderate or high likelihood of occurring in the non-certified land within the study area.

State Environmental Planning Policy (Sydney Region Growth Centre's) 2006

Under State Environmental Planning Policy (Sydney Region Growth Centre's) 2006 (Growth Centre's SEPP), the investigation area is within the Blacktown Growth Centres Precinct. Clause 18A of the Growth Centre's SEPP confirms that public utility undertakings (which would include the proposal) may be undertaken without development consent. Clause 18A also requires notification of the Department of Planning and Environment in relation to the clearing of native vegetation on land that is within a growth area but not subject to biodiversity certification.

1.5 Study area

The study area for the purposes of this biodiversity assessment includes 1.6 kilometres of Richmond Road north of Elara Boulevard and adjacent land to account for the area that would be directly and indirectly impacted by construction and operation of the proposal as shown in [Figure 1-2.1](#) and [Figure 1-2.2](#). It includes the total construction footprint, access roads, compound site, off-site flood storage area, sediment basins and any other areas that would be temporarily disturbed

The following areas are discussed throughout the report and are defined as:

- § The study area: this area comprises the physical limits of the construction footprint, compound site location, and off-site flood storage area, (see [Figure 1-2.1](#) and [Figure 1-2.2](#)) and has taken into account all potential direct construction impacts.
- § Locality: This is defined as the area within a 10-kilometre radius surrounding the proposal footprint
- § Bioregion: The study area is located in the Sydney Basin bioregion (Thackway and Cresswell, 1995) and within Cumberland sub-region.
- § Certified lands – certified land in accordance with the Sydney Growth Centres SEPP 2006. Certified areas do not need to undertake assessment of impacts on threatened species, populations and ecological communities, or their habitats.
- § Non-certified lands – areas of the project that fall outside of the mapped certified lands. Subject to assessment of impacts on threatened species, populations and ecological communities, or their habitats

Section 5AA of the EP&A Act require that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act is assessed using the test of significance. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General's requirements.

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Roads and Maritime activities being assessed under Part 5 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 a 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 for NSW 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* (DoE 2013).

Part of the study area is located with the Sydney Region Growth Centre, details regarding the relevance of the State Environmental Planning Policy (Sydney Region Growth Centres) to this project is described below.

1.4.1 Biodiversity Certification of the State Environmental Planning Policy (Sydney Region Growth Centres) 2006

The Growth Centres SEPP established the broad framework for development of the Growth Centres over the next 25 to 30 years. An order conferring Biodiversity Certification on the Growth Centres SEPP was made by the Minister for the Environment under section 126G of the then TSC Act.

The Biodiversity Certification Order provides that any developments or activities proposed to be undertaken within certified areas do not need to undertake assessment of impacts on threatened species, populations and ecological communities, or their habitats, that would normally be required by Parts 3, 4 or 5 of the EP&A Act. Development within non-certified land within the Growth Centres requires assessment under normal legislative requirements.

The study area falls within Biodiversity certified and non-certified lands (see [Figure 1-2.1](#) and [Figure 1-2.2](#)). Parts of the investigation area north of South Creek and some sections north of Richmond Road are not certified. Elements of the study area that fall outside of the Biodiversity certified area require assessment of significance under NSW and Commonwealth impact assessment legislation.

1.4.2 Commonwealth Strategic Assessment of the Sydney Growth Centres

The Department of Planning, Industry and Environment (DPIE) in consultation with the then Department of Environment and Energy (DoEE) (DoP, 2010), undertook a Commonwealth Strategic Assessment under the EPBC Act of the Sydney Growth Centres Program (the Program). On 20 December 2011, the Commonwealth Environment Minister endorsed the Program. On 28 February 2012, the Minister approved all actions associated with the development of the Western Sydney Growth Centres as described in the Sydney Growth Centres Commonwealth Strategic Assessment: Program report.



- Legend**
- █ Proposal area
 - Watercourse
 - █ Waterbody
 - █ NPWS reserve
 - █ Local parks
 - Local government area (LGA)



Data sources

Jacobs 2020
 Ausimage 2018
 NSW Spatial Services 2020

GDA94 MGA56
 Version: 19/10/2020

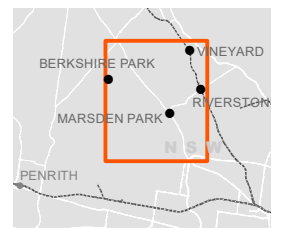
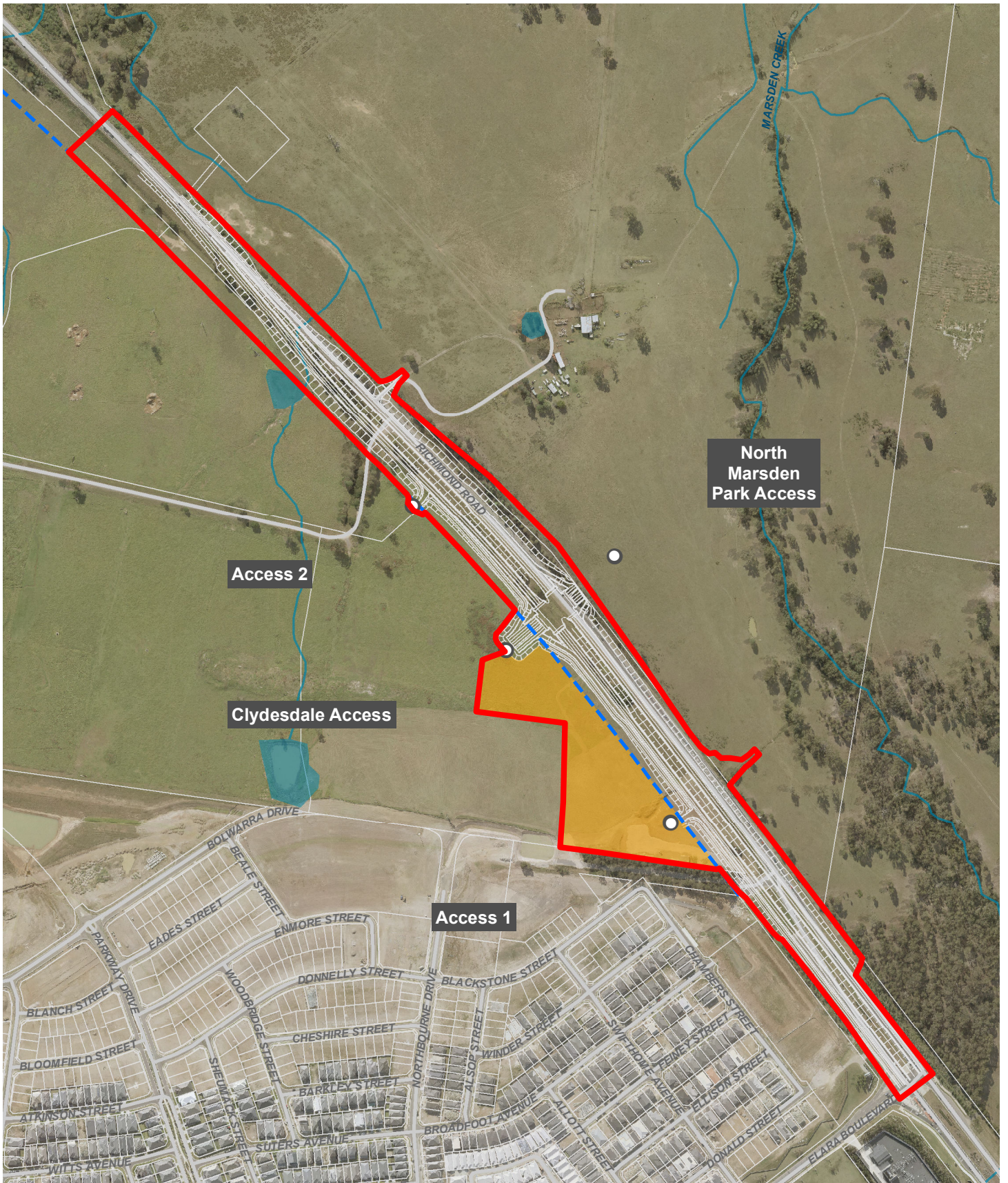
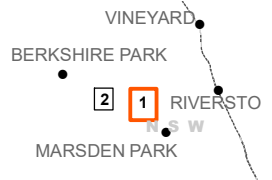


Figure 1-1 Proposal context



- Legend**
- Ancillary facility
 - - - Proposed future road reserve boundary
 - - - Proposed road design
 - Watercourse
 - Waterbody

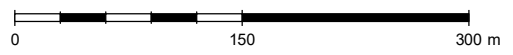


Data sources
 Jacobs 2020
 Ausimage 2018
 NSW Spatial Services 2020
 GDA94 MGA56
 Version: 19/10/2020

Figure 3-1.1 Vegetation on site



- Legend**
- Watercourse
 - Waterbody



1:5,000 at A4

Data sources
 Jacobs 2020
 Ausimage 2018
 NSW Spatial Services 2020
 GDA94 MGA56
 Version: 19/10/2020

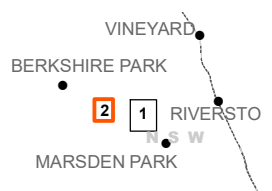


Figure 3-1.2 Vegetation on site

2. Methods

2.1 Personnel

The work to prepare this biodiversity assessment was undertaken by appropriately qualified and experienced ecologists as outlined in [Table 2-1](#).

Table 2-1: Personnel, role and qualifications

Name	Role	Qualifications
Tim Maher	Ecologist – Field surveys and reporting	Bachelor of Advanced Science (Biology) Master of Research (Plant Ecology)
Julia Bayada	Ecologist – Field surveys and reporting	Bachelor of Environmental Science & Management
Chris Thomson	Principal Ecologist – Technical review	Graduate Certificate in Natural Resources Bachelor of Applied Science (Environmental Management) Accredited under section 6.10 of the <i>Biodiversity Conservation Act 2016</i> as a Biodiversity Assessment Method Assessor (No. BAAS18058)

2.2 Background research

A background review of existing information was undertaken to identify the existing environment of the proposal within a search area of 10 kilometres. The review focused on database searches, relevant ecological reports pertaining to the study area, particularly the preliminary environmental investigation prepared for Richmond Road upgrade between Elara Boulevard and South Creek (Roads and Maritime Services, 2018). The review was used to prepare a list of threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. A minimum search area of 10 km was undertaken for the majority of database searches. The searches were also undertaken to identify if an Areas of Outstanding Biodiversity Value were present.

The following database searches were performed:

- § BioNet – Atlas of NSW Wildlife: <http://www.bionet.nsw.gov.au>
- § NSW DPIE BioNet Vegetation Classification: <http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx>
- § NSW Threatened Biodiversity Data Collection: <http://www.environment.nsw.gov.au/atlasapp/>
- § NSW DPI Threatened and protected species – records viewer: <http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer>
- § DoAWE Protected Matters Search Tool (PMST): <http://www.environment.gov.au/epbc/protected-matters-search-tool>
- § NSW DPI Weed Wise: <http://weeds.dpi.nsw.gov.au/>
- § Atlas of Living Australia: <http://www.ala.org.au/>

The background research also considered the following sources of data:

Regional vegetation mapping projects including the Remnant Vegetation Mapping of the Cumberland Plain (crown cover less than 10 per cent). VIS_ID 2222, Remnant Vegetation Mapping

of the Cumberland Plain (crown cover greater than 10 per cent). VIS_ID 2221 (Office of Environment and Heritage NSW, 2011).

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act was viewed on the OEH NSW Threatened Species Scientific Committee website (NSW Department of Planning, 2020). There were no preliminary or provisional listings of relevance to the proposal.

The annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act was reviewed (period commencing 1 October 2019) (Department of the Environment and Energy, 2017). None of the nominated species and ecological communities are of relevance to the proposal.

Area of Outstanding Biodiversity Value register available on the NSW DPIE website:
<https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value>

Biodiversity *certified* lands mapping which is based on the Draft Conservation Plan established in 2007 as part of the Growth Centres Biodiversity Certification that has since been updated by DPIE.

ENV mapping from the Draft Conservation Plan established in 2007 as part of the Biodiversity Certification will be used to calculate impact and offsets for the project.

2.3 Habitat assessment

A habitat assessment was undertaken within the study area to address the identified list of threatened flora and fauna species known or predicted to occur in the Cumberland IBRA subregion that have been recorded within a 10-kilometre radius of the 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. subject 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 2-2](#). The results of the habitat assessment are provided in Appendix B.

Table 2-2 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 (10 kilometres) 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 (10 kilometres). 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.

2.4 Field survey

Two separate field surveys were undertaken within the ecological study area on the 26 March and 4 June 2020 to ground-truth the results of the background research and habitat assessment.

2.4.1 Vegetation surveys

The vegetation survey was completed using field survey methods in line with Chapter 5 of the Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a). Random meander surveys were undertaken using paired parallel transects throughout the study area to survey vegetation. A plot-based vegetation survey of the study area was also undertaken. Plot surveys were targeted to characterize any roadside vegetation patches within the study area.

The broad scale vegetation mapping and aerial photography reviewed during the desktop assessment was used to initially identify vegetation extent. The initial vegetation mapping was ground-truthed while in the field and where possible assigned to Plant Community Types (PCTs) according to the OEH BioNet Vegetation Classification Database. Surveys assessed the environmental variation within the study area and any areas with gaps in existing mapping and site information to determine vegetation zones.

A vegetation integrity assessment was then undertaken on each vegetation zone in accordance with Chapter 5 of the BAM. The plot-based floristic survey used multiple 400 square metre plots around a central 50 metre transect to assess vegetation structure and composition attributes (species richness and foliage cover). Function attributes (number of large trees, tree stem size class, tree regeneration and length of fallen logs) were recorded within the larger 1000 square metre plot. Litter cover was assessed as the average percentage ground cover of litter recorded from five 1 metre x 1 metre plots evenly located along the central transect. The number of trees with hollows was determined by counting the number of trees with hollows that are visible from the ground in the 1000 square metre plot. All data was collected according to the methods described in Chapter 5 of the BAM.

A summary of vegetation survey effort, outlining the number of vegetation zones and respective number of floristic plots is presented in [Table 2-3](#). The location of each floristic plot is shown in [Figure 3-1.1](#).

Table 2-3 Summary of PCT / vegetation zones survey effort in study area

Vegetation Zone Number	Plant Community Type (PCT)	Condition	Area (ha)	Certified area or non-Certified area	No. plots/transects sampled
1	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate / Good	0.83	Certified area	1 plot (Plot 1)
2	Not assigned to the PCT, comprises non-native vegetation (highly disturbed areas – cleared paddocks, road verges, table drains, road embankments, ploughed paddocks etc.	N/A	1.38	Non-certified area	(Plot 2) No plots required in accordance with the BAM, however 1 plot was completed. A meander survey was completed in the off-site flood storage area.

2.4.2 Targeted flora surveys

The surveys undertaken for all identified candidate flora species considered those species rated as moderately likely to occur within the study area (see Table 2-4) and followed the methods described in the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016) with random meander surveys through the habitat undertaken using paired parallel transects. The floristic plot surveys also provided opportunity to record threatened species in discreet areas if they were present.

The threatened flora species targeted, and details of the surveys undertaken are outlined in [Table 2-4](#).

2.4.3 Targeted fauna surveys

Targeted surveys for the Cumberland Plain Land Snail were undertaken throughout the entire study area during the survey and followed the methods described in the *Environmental Impact Assessment Guidelines Cumberland Plain Large Land Snail* (NPWS, 2000).

Searches for Cumberland Plain Land Snail involved looking for active specimens on tree trunks, turning over suitable ground shelter including fallen timber, sheets of iron and exposed rocks and rubble, raking back bark, litter and debris from the ground, and searching in dense grass clumps. This was carried out along the length of the study area, where suitable habitat was encountered.

Other fauna surveys were not undertaken during the field work for this proposal. Where a species has not been surveyed, the habitat assessment has been used to determine the likelihood of occurrence.

Survey conducted for this species and how it meets the relevant guidelines is summarised in [Table 2-4](#).

2.4.4 Aquatic Surveys

An aquatic habitat assessment was conducted to assess the unnamed first-order stream (dry at the time) against the NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (NSW Department of Primary Industries, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). These guidelines provide information for waterway classification and describe ways to minimise potential impacts of road projects on fish and other aquatic wildlife by protecting aquatic habitat and maintaining fish passage. The habitat assessment was visual only and no fish surveys or macroinvertebrate surveys were conducted. The aim of the habitat assessment was to identify the presence of 'key fish habitat'.

Habitat assessment for threatened aquatic species was undertaken for the first-order stream. Aquatic habitats were assessed by examining characteristics such as the structure and floristics of aquatic vegetation, channel width, the presence of surface water, the presence of shelter (rocks, submerged vegetation and woody debris), and channel substrate.

The habitat characteristics observed did not match the habitat characteristics of any threatened aquatic species known or predicted to occur in the locality hence targeted surveys for aquatic species were not undertaken.

2.4.5 Summary of survey effort

Table 2-4 Targeted species survey techniques and survey effort

Species	Minimum survey requirements	Survey completed
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	<p>M. corneovirens can be surveyed year round and it is not necessary to wait until after wet weather. The minimum time required will depend on the size and amount of potential habitat present within the site being assessed.</p> <p>Assessment of a site should consider:</p> <ul style="list-style-type: none"> • the amount of ground cover present and the number of living individuals observed • the quality of the habitat present • whether the site is at the edge of the species or an extension to the species current known range • the long-term security of the site. 	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>Searches for Cumberland Plain Land were carried out along the length of the study area, where suitable habitat was encountered.</p> <p>The survey was undertaken in an appropriate season to detect this species.</p>
<i>Acacia pubescens</i>	<p>A parallel field traverse (i.e. parallel transects) was undertaken in areas of potential habitat. As a medium shrub the maximum distance between transects in open vegetation such as that in the study area is 20 metre. In open vegetation, the recommended field traverse length is 0.5 kilometre per hectare of potential habitat. Recommended survey time is estimated at 0.13 hours.</p> <p>Surveys for <i>Acacia pubescens</i> can be undertaken year-round.</p>	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>The survey was undertaken in an appropriate season to detect this species.</p>

Species	Minimum survey requirements	Survey completed
		This species was not identified during the survey undertaken for this proposal.
<i>Dillwynia tenuifolia</i>	<p>A parallel field traverse (i.e. parallel transects) was undertaken in areas of potential habitat. As a medium shrub the maximum distance between transects in open vegetation such as that in the study area is 20 metre. In open vegetation, the recommended field traverse length is 0.5 kilometre per hectare of potential habitat. Recommended survey time is estimated at 0.13 hours.</p> <p>Surveys for <i>Dillwynia tenuifolia</i> can be undertaken year-round.</p>	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>The survey was undertaken in an appropriate season to detect this species.</p> <p>This species was not identified during the survey undertaken for this proposal.</p>
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	<p>A parallel field traverse (i.e. parallel transects) was undertaken along the entire study area. As a medium shrub the maximum distance between transects in open vegetation such as that in the study area is 20 metre. In open vegetation, the recommended field traverse length is 0.5 kilometre per hectare of potential habitat. Recommended survey time is estimated at 0.13 hours.</p> <p>Surveys for <i>Grevillea juniperina</i> subsp. <i>juniperina</i> can be undertaken year-round.</p>	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>The survey was undertaken in an appropriate season to detect this species.</p> <p>This species was identified during the survey undertaken for this proposal.</p>
<i>Persoonia nutans</i>	<p>A parallel field traverse (i.e. parallel transects) was undertaken in areas of potential habitat. As a medium shrub the maximum distance between transects in open vegetation such as that in the study area is 20 metre. In open vegetation, the recommended field traverse length is 0.5 kilometre per hectare of potential habitat. Recommended survey time is estimated at 0.13 hours.</p> <p>Surveys for <i>Persoonia nutans</i> can be undertaken year-round.</p>	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>The survey was undertaken in an appropriate season to detect this species.</p> <p>This species was not identified during the survey undertaken for this proposal.</p>
<i>Pimelea spicata</i>	<p>A parallel field traverse (i.e. parallel transects) was undertaken in areas of potential habitat. As an herb the maximum distance between transects in open vegetation such as that in the study area is 10 metre. In open vegetation, the recommended field traverse length is 1 kilometre per hectare of potential habitat. Recommended survey time is estimated at 0.25 hours.</p> <p>Surveys for <i>Pimelea spicata</i> can be undertaken year-round.</p>	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>The survey was undertaken in an appropriate season to detect this species.</p>

Species	Minimum survey requirements	Survey completed
		This species was not identified during the survey undertaken for this proposal.
<i>Pultenaea parviflora</i>	<p>parallel field traverse (i.e. parallel transects) was undertaken in areas of potential habitat. As a medium shrub the maximum distance between transects in open vegetation such as that in the study area is 20 metre. In open vegetation, the recommended field traverse length is 0.5 kilometre per hectare of potential habitat. Recommended survey time is estimated at 0.13 hours.</p> <p>Surveys for <i>Pultenaea parviflora</i> can be undertaken year-round.</p>	<p>Transects were walked through the entire study area by two ecologists over a period of approximately 5 hours (10 - person hour of survey).</p> <p>The survey was undertaken in an appropriate season to detect this species.</p> <p>This species was not identified during the survey undertaken for this proposal.</p>

2.5 Limitations

The vegetation field survey was able to provide adequate spatial coverage and survey effort for the entire study area. This was achievable in the timeframe given the small size of the study area. Detailed floristic survey was undertaken to provide a list of flora species for that point in time. Additional flora species may appear in other times of the year, particularly cryptic orchids. A period of several seasons or years is often needed to identify all the species present in an area, and specific weather conditions are required for optimum detection (e.g. breeding and flowering periods). The conclusions of this report are therefore based upon available data and limited field survey and are indicative of the environmental condition of the study area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species.

The mapping included in this report shows the inferred distribution of plant community types and habitat within the study area. In many cases, the boundaries between plant community types and habitats are not well-defined and the mapping provides an approximation of on-ground conditions. The maps represent a snapshot in time.

3. Existing environment

3.1 Landscape context

The study area is located within the Cumberland sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995) and partly between the Hawkesbury - Nepean Channels and Floodplains and Hawkesbury - Nepean Terrace Gravels Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (2002a) and described by the NSW Department of Environment and Climate Change (2008). The Hawkesbury - Nepean Channels and Floodplains Mitchell Landscape is an over cleared landscape with 79 per cent of native vegetation having been cleared. Only 21 per cent of the original native vegetation remains. The Hawkesbury - Nepean Terrace Gravels Mitchell Landscape is not classed as over-cleared, but 69 per cent of its native vegetation has been cleared. Only 31 per cent of the original native vegetation remains.

The landscape is predominantly low rolling hills and wide valleys in a rain shadow area below the Blue Mountains (Morgan, 2001). Geology is dominated by undifferentiated middle Triassic Wianamatta group shales (Bringelly Shale) (Clarke and Jones, 1991). Soils overlying the Wianamatta Shale are of the residual Blacktown soil landscape (Hazelton et al., 1989, Morgan, 2001, Department of Environment and Climate Change, 2008).

The study area is situated in an extensively cleared landscape where roadside vegetation, cleared paddocks and small scattered bushland remnants form the bulk of the remaining vegetation. The PCTs within the study area are described in Section 3.2.

The aquatic environment is limited to an unnamed creek (Strahler 1st order stream) that is mapped as draining from the south of Richmond Rd to the north on to private property DP715318 before discharging into South Creek. However, there is no drain bridging this creek across Richmond Rd. The habitat quality for fish is poor (discussed in Section 3.6). There are no wetlands of significance (State Environmental Protection Policy 44 wetlands or wetlands listed in the Directory of Important Wetlands) in or adjacent to the study area.

3.1.1 Biodiversity certified areas

Based on the Biodiversity Certification process for areas marked for development at the strategic planning stage, development may proceed in Biodiversity certified areas without the usual requirement under the EP&A Act for threatened species assessments (NSW OEH, 2015). The certified areas within the study area have been previously cleared and mostly comprise of native grasses and weeds. The proposal contained no vegetation mapped as 'Existing Native Vegetation' (ENV) on certified land.

3.1.2 Non – biodiversity certified areas

Non-Biodiversity certified areas are those outside of Biodiversity certified land described in Section 3.1.1 where biodiversity impact assessment is required. Within the study area, these areas total about 1.38 hectares and contain 0.14 hectares of foraging habitat (mix of mature, native tree species), as well as highly disturbed areas – cleared paddocks, road verges, table drains, road embankments etc. The disturbed areas contain exotic grassland dominated by weeds. The proposal contained no vegetation mapped as 'Existing Native Vegetation' (ENV) on non-certified land.

3.2 Plant community types

Non-certified land (according the NSW Government Bio-certification Order 2007) within the study area contains no recognised plant community types. A remnant of the Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) was identified on certified land within the study area. This PCT was identified based on floristic composition, geological substrate, and landscape position with regard to relevant regional vegetation classifications. The remainder of the

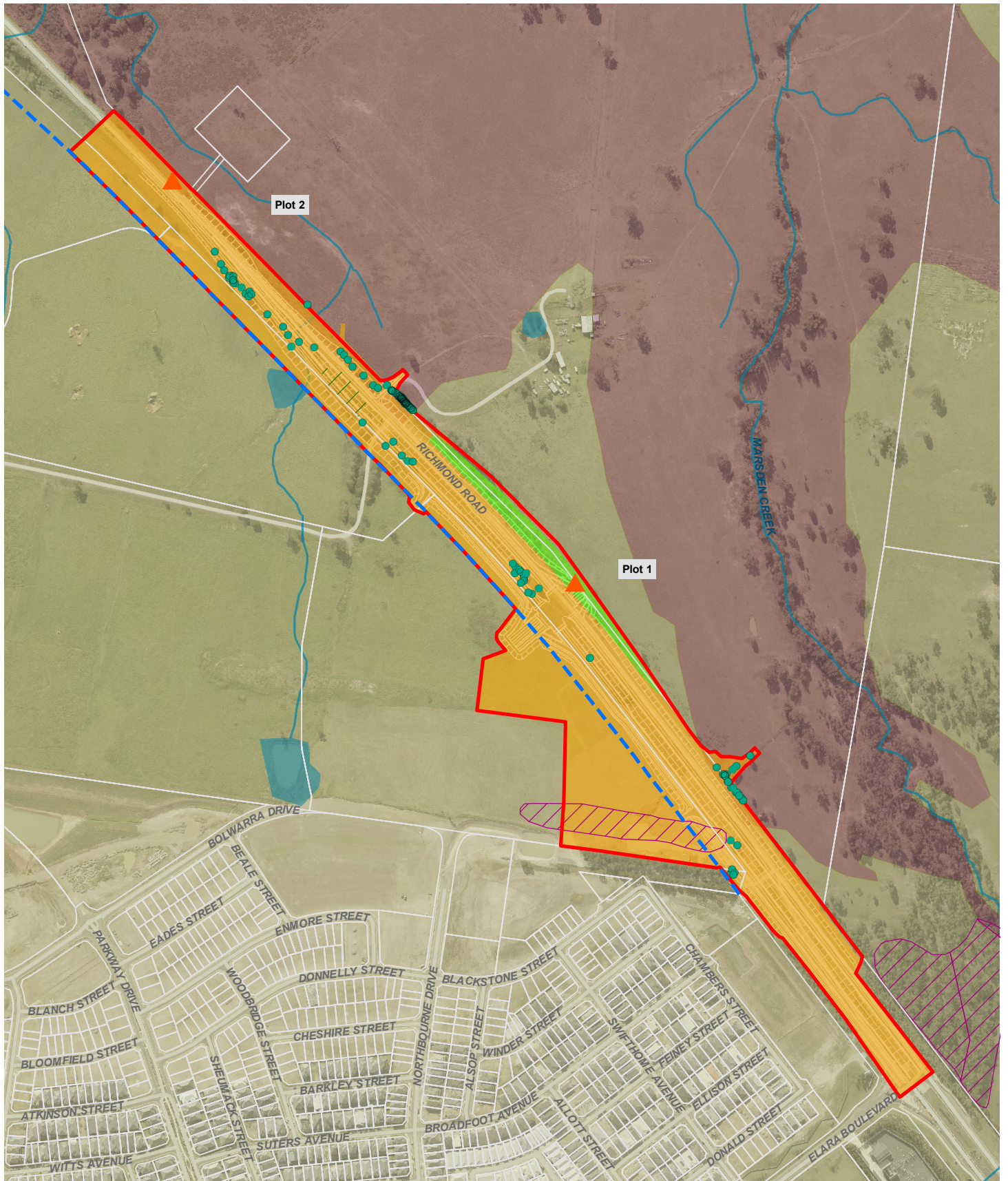
study area contains strips of remnant roadside trees, as well as highly disturbed areas containing weeds – cleared paddocks, road verges, table drains, road embankments etc. The remnant roadside trees consisted of: *Eucalyptus moluccana*, *Eucalyptus crebra*, *Acacia decurrens*, *Eucalyptus amplifolia*, *Angophora floribunda*, *Melaleuca decora*, *Eucalyptus tereticornis* and *Casuarina cunninghamiana*. These occurred amongst the cleared and disturbed areas containing exotic grassland dominated by weeds. Past and present land use activities such as land clearing, weed and pest invasion, rubbish dumping, and human disturbance have modified the extent and condition of native vegetation in the study area and locality.

The PCTs and other vegetation identified within the study area are outlined in [Table 3-1](#) and illustrated in [Figure 3-1.1](#) and [Figure 3-1.2](#).

Table 3-1 Vegetation in study area

Plant community type (PCT)	Condition class	Vegetation formation	Percent cleared in major catchment area	Threatened ecological community ?	Land certification	Area (hectares) in study area
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Moderate/ Good	Grassy Woodlands	93	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC BC Act. Doesn't meet key diagnostic features and condition thresholds for ecological Community under EPBC.	Certified	0.83
Highly disturbed areas – cleared, paddocks, road verges, table drains, road embankments etc.	NA	NA	NA	No	Non-certified	1.38
Highly disturbed areas – cleared, paddocks, road verges, table drains, road embankments etc.	NA	NA	NA	No	Certified	21.59
Mix of mature, native tree species (<i>Eucalyptus moluccana</i> , <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Melaleuca decora</i>)	NA	NA	NA	No	Non-certified	0.14

Plant community type (PCT)	Condition class	Vegetation formation	Percent cleared in major catchment area	Threatened ecological community ?	Land certification	Area (hectares) in study area
and <i>Eucalyptus tereticornis</i>)						
Mix of mature, native tree species (<i>Eucalyptus moluccana</i> , <i>Eucalyptus crebra</i> , <i>Acacia decurrens</i> , <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Eucalyptus tereticornis</i> and <i>Casuarina cunninghamiana</i>)	NA	NA	NA	No	Certified	0.27



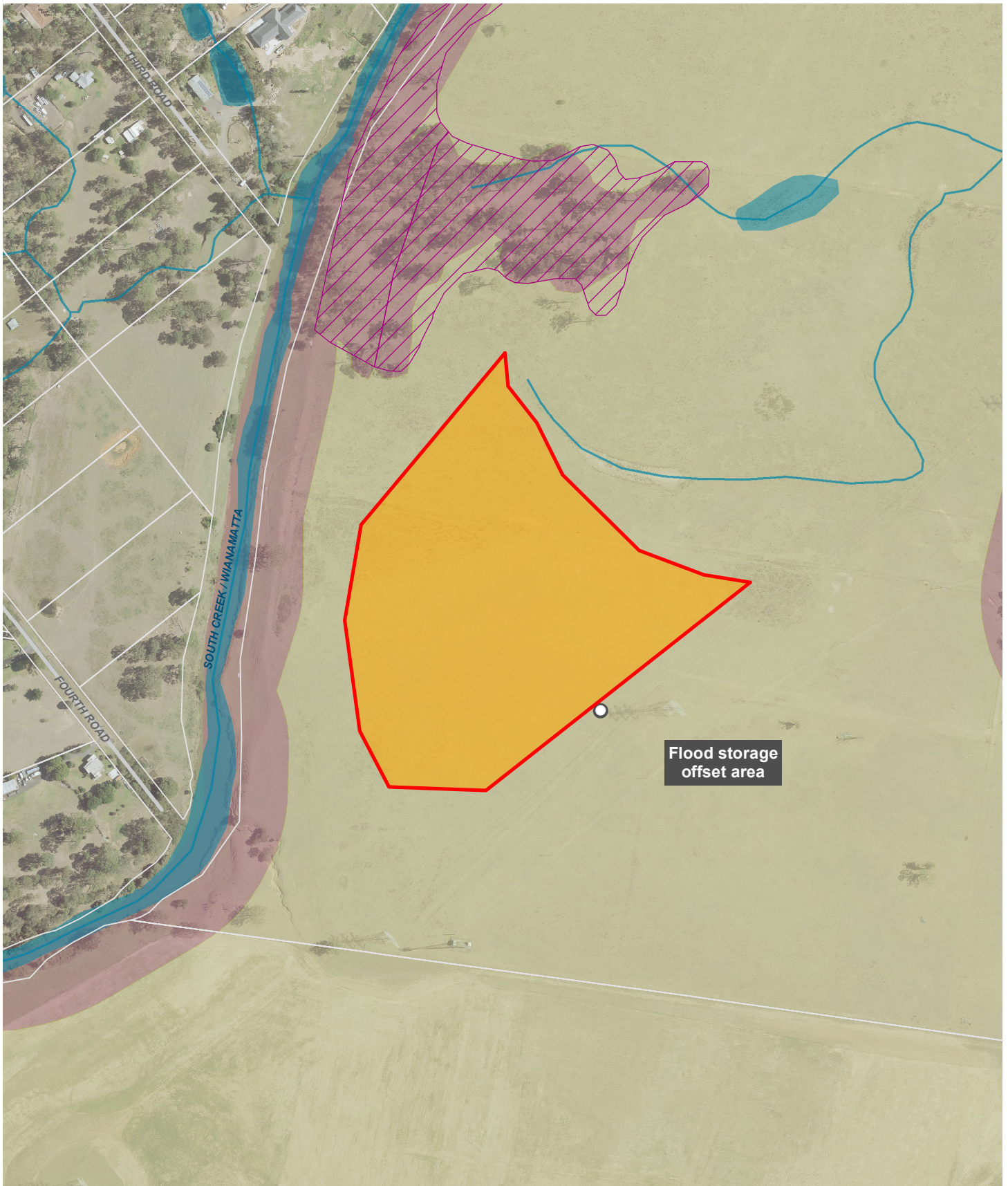
- Legend**
- Construction footprint
 - Proposed future road reserve boundary
 - Proposed road design
 - Watercourse
 - Waterbody
 - Mix of mature, native tree species (foraging habitat)
 - Mix of mature, native tree species
- Figure 3-1.1** Vegetation on site

- Land certification (SEPP (Sydney Region Growth Centres) 2006)**
- Certified
 - Non-certified
 - Existing Native Vegetation

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)
- Highly disturbed areas containing weeds – cleared, paddocks, road verges, table drains, road embankments etc.
- ▲ Floristic plots

Data sources
 Jacobs 2020
 Ausimage 2018
 OEH 2020
 NSW Spatial Services 2020
 GDA94 MGA56

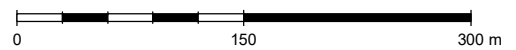




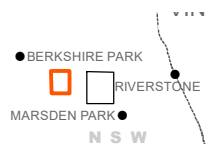
Legend

- Construction footprint
 - Proposed road design
 - Watercourse
 - Waterbody
- Land certification (SEPP (Sydney Region Growth Centres) 2006)**
- Certified
 - Non-certified
 - Existing Native Vegetation

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)
- Highly disturbed areas containing weeds – cleared, paddocks, road verges, table drains, road embankments etc.



1:5,000 at A4



Data sources

- Jacobs 2020
- Ausimage 2018
- GEH 2020
- NSW Spatial Services 2020
- GDA94 MGA56

Figure 3-1.2 Vegetation on site

Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) - Moderate / Good

Vegetation formation: Grassy Woodlands

Vegetation class: Coastal Valley Grassy Woodlands

Conservation status: Critically Endangered Ecological Community (BC Act): Cumberland Plain Woodland in the Sydney Basin Bioregion.

Estimate of percent cleared: 93 per cent

Extent in the study area: 0.83 hectares (within certified lands only)

Plots completed in vegetation zone: 1

Species by stratum	Height range (metre)	Foliage cover estimate (per cent)	Typical species
Upper	10 – 20	33	<i>Eucalyptus moluccana</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus fibrosa</i>
Middle	1 – 6	10	<i>Bursaria spinosa</i> , <i>Acacia decurrens</i> , <i>Acacia falcata</i>
Ground	0 – 1	23	<i>Microlaena stipoides</i> , <i>Chloris gayana</i> *, <i>Aristida vagans</i> , <i>Dichondra repens</i> , <i>Dianella longifolia</i> , <i>Hypochaeris radicata</i> *, <i>Briza subaristata</i> *, <i>Mentha satureoides</i> , <i>Paspalidium distans</i> , <i>Lomandra multiflora</i> , <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>

Description:

The gentle topography associated with the shale plains of western Sydney carries an open grassy woodland dominated by *Eucalyptus moluccana*, *Eucalyptus tereticornis* and *Eucalyptus crebra/Eucalyptus fibrosa*. Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) (Office of Environment and Heritage, 2017b). Tozer et al. (2006) define the primary habitat for the community as occurring at elevations less than 150 metres above sea level with some sites occurring at higher elevations where the landscape remains gently inclined.

Within the study area, PCT 849 - Moderate / Good is located in one area of the road verge east of the Richmond Rd. The canopy contains *Eucalyptus moluccana*, *Eucalyptus crebra* and *Eucalyptus fibrosa*. The mid-storey contains *Bursaria spinosa*, *Acacia spp.* and *Grevillea juniperina* subsp. *juniperina*. The groundcover is moderately dense and dominated by native grasses (notably *Paspalidium distans* and *Microlaena stipoides* with approximately 11% cover). This area does not meet the key diagnostic features and condition thresholds for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community under the EPBC Act, as only 0.46 hectares of the community meets the minimum projected foliage cover of 10 per cent for native tree species (Department of the Environment, 2010).

Fauna habitat values are moderate. No hollow bearing trees were present in the plot which limits the habitat suitability for nesting and roosting. No large trees above the 50 centimetre DBH threshold were present in the plot. The canopy provides foraging opportunities. No large woody debris was recorded in the ground layer which limits sheltering and foraging opportunities for some fauna groups. The habitat does still provide some good sheltering and foraging value with leaf litter layer (average cover of 40 per cent) and dumped refuse providing opportunity for ground dwelling species, including the threatened Cumberland Plain Land Snail, to find shelter sites.

The Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) - Moderate / Good as it occurs in the study area is shown in Photograph 1.



Photograph 1: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) - Moderate / Good adjacent property DP715318 to the north of Richmond Rd.

Highly disturbed areas – cleared paddocks, road verges, table drains, road embankments etc

Vegetation formation: NA

Vegetation class: NA

Conservation status: NA

Estimate of percent cleared: NA

Extent in the study area: 21.59 hectares

Plots completed in vegetation zone: Random meander undertaken to record typical species

Species by stratum	Height range (metres)	Foliage cover estimate (per cent)	Typical species
Upper	NA	0	None
Middle	NA	0	None
Ground	0 – 1	100	<i>Cenchrus clandestinus</i> *, <i>Eragrostis curvula</i> *, <i>Sida rhombifolia</i> *, <i>Anredera cordifolia</i> *, <i>Chloris gayana</i> *, <i>Araujia sericifera</i> *, <i>Brunoniella australis</i> , <i>Senecio madagascariensis</i> *, <i>Cirsium vulgare</i> *, <i>Plantago lanceolata</i> *, <i>Sonchus oleracea</i> *, <i>Crassula multicaeva</i> *, <i>Chlorophytum comosum</i> *, <i>Avena</i> sp.*, <i>Lactuca serriola</i> *, <i>Verbena bonariensis</i> *, <i>Conyza bonariensis</i> *

*Exotic species

Description:

The study area contains areas that are highly disturbed, associated with the road verges, table drains and road embankments along Richmond Road and the site of the flood storage area which contains cleared paddocks. The vegetation in these areas is either mown or left to grow a tall exotic grass and herb layer. Dominant species include the exotic grass species *Cenchrus clandestinus*, *Eragrostis curvula*, *Paspalum dilatatum* and *Chloris gayana* with exotic herbs *Senecio madagascariensis*, *Solanum sisymbriifolium*, *Cirsium vulgare*, *Plantago lanceolata*, *Sonchus oleracea*, *Lactuca serriola*, *Vicia sativa*, *Taraxacum officinale*, *Verbena bonariensis*, *Trifolium repens*, *Sida rhombifolia*, *Bidens pilosa*, *Modiola caroliniana*, *Malva neglecta* and *Conyza bonariensis*.

Fauna habitat values are considered to be low as these are open grassed areas with few habitat features. The habitat rarely contains any native groundcover species and generally is dominated by a dense tall sward of exotic grasses (generally dominated by *Chloris gayana*, *Eragrostis curvula* or *Cenchrus clandestinus*). These areas of vegetation have grown on former constructed embankments and are not matched to a PCT.

The Highly disturbed areas – cleared paddocks, road verges, table drains, road embankments etc. as it occurs in the study area is shown in Photograph 2.



Photograph 2: Highly disturbed areas – cleared paddocks, road verges, table drains, road embankments, ploughed paddocks etc dominated by weeds on the road embankment east of Richmond Road

3.3 Priority weeds

Priority weeds for the Greater Sydney region were identified within the study area, including:

- § *Anredera cordifolia* (Madeira vine) – located in the road reserve and will be cleared by the proposal. No specific measures are required under the *Biosecurity Act 2015* for this species in this region.
- § *Senecio madagascariensis* (Fireweed) – located in the road reserve and off-site flood storage area and will be cleared by the proposal. No specific measures are required under the *Biosecurity Act 2015* for this species in this region.

The General Biosecurity Duty applies to all priority weed species. All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

3.4 Threatened ecological communities

No threatened ecological communities (TECs) listed under the BC Act were identified in the non-certified area of the study area.

In the certified area of the study area, a patch of Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) was identified in good/moderate condition. Removal of 0.83 hectares of this PCT is required for the proposal, from certified lands only.

This vegetation appears to be regrowth on the road verge. This PCT is associated with the Critically Endangered Ecological Community (BC Act): Cumberland Plain Woodland in the Sydney Basin Bioregion. This PCT does not meet the key diagnostic features and condition thresholds to be identified as a Critically Endangered Ecological Community under the EPBC Act (Department of the Environment, 2010)

3.5 Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the study area has been identified using the Atlas of GDEs (Bureau of Meteorology, 2017) and the *Risk Assessment Guidelines for Groundwater Dependiant Ecosystems* released by the NSW DPI (Kuginis et al., 2012). The Atlas of GDEs (Bureau of Meteorology, 2017) identified no groundwater dependent terrestrial vegetation in the study area, or any aquatic or subterranean GDEs. The Atlas of GDEs dataset uses the same polygons as the *Southeast NSW Native Vegetation Classification and Mapping – SCIVI (VIS_ID 2230)* (State Government of NSW and Office of Environment and Heritage, 2010) and does not provide a fine scale map of GDEs so must be used as a guide only.

While Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) is considered with a high likelihood to be a GDE (Kuginis et al., 2012), this PCT is not an obligate GDE (i.e. they are not entirely dependent on groundwater). These PCTs are not restricted to locations of groundwater discharge and are not located within aquifers. This PCT is likely to be an opportunistic facultative GDE that depends on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) in some locations but not in others, particularly where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function (Kuginis et al., 2012). The plants within this PCT would use shallow soil water before seeking deeper soil water or groundwater. The trees may take up groundwater from the capillary fringe when necessary (e.g. during dry seasons or in extended drought).

3.6 Threatened species and populations

3.6.1 Threatened flora species

Thirty threatened flora species and one endangered population have been previously recorded or modelled as having potential to occur in the locality (see Appendix B). Many of these species favour habitats that are not represented in the study area or are only known to exist in populations restricted to specific localities (e.g. alluvium of the Eastern Creek floodplain) or are presumed extinct.

One threatened flora species was recorded in the study area during the field survey undertaken for the proposal: *Grevillea juniperina* subsp. *juniperina* (See [Figure 3-2](#)). An estimated twenty individuals of this species were found on non-certified land in the study area. This was found in the road verge next to the property fence of DP715318 north of Richmond Rd. On certified land, in the study area, about 500 individuals were identified in the road verge and roadside fragment of Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) east of Richmond Rd.

The habitats in the study area are not considered optimal for any of the remaining threatened flora species listed in Appendix B due to the degraded nature of the vegetation, mowing regimes, disturbance to the soil, and dominance of exotic species. Overall, threatened flora species are unlikely to occur (see Appendix B).

3.6.2 Threatened fauna species

Based on regional records and the presence of suitable habitat, 49 threatened fauna species have been identified in the locality (see Appendix B) or have modelled habitat. This includes 14 mammals, 29 birds, three frogs and three invertebrates. The study area does not contain suitable habitat for some species listed in Appendix B. The habitats within the study area are generally poor quality and do not possess the features required for many of the threatened species listed in Appendix B to complete their life cycles.

However, some threatened fauna are still considered moderately or highly likely to occur (see [Table 3-3](#)). No suitable habitat for threatened fish is present in the study area.

The Cumberland Plain Land Snail was not found in the non-certified area in the study area during the surveys undertaken for the proposal (See [Figure 3-2](#)). Two specimens were found under roadside refuse in the roadside fragment of Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) adjacent property DP715318 north of Richmond Rd. It is likely that the habitat is at least moderately suitable in the non-certified area in the study area.

The study area also provides some habitat for the Greater Broad-nosed Bat, Large Bent-winged Bat, Little Bent-wing Bat, Eastern False Pipistrelle, Eastern Freetail-bat, Southern Myotis, Large-eared Pied Bat, Greater Broad-nosed Bat (all listed as vulnerable under the BC Act). These species have either been recorded widely in the locality or have been modelled to occur based on suitable habitat in the locality and are likely to forage in the study area. Tree hollows aren't present, but the trees in the study area are likely to be suitable as foraging habitat (See [Figure 3-2](#)).

The Grey-headed Flying-fox (listed as vulnerable under the BC Act and EPBC Act) is considered moderately likely to forage in the mature Eucalypt and *Melaleuca* trees within the study area, particularly *Eucalyptus moluccana*. No roost camps are present in the study area but the bats from the Ropes Crossing, Emu Plains, Yarramundi and Penrith camps are moderately likely to forage in the study area.

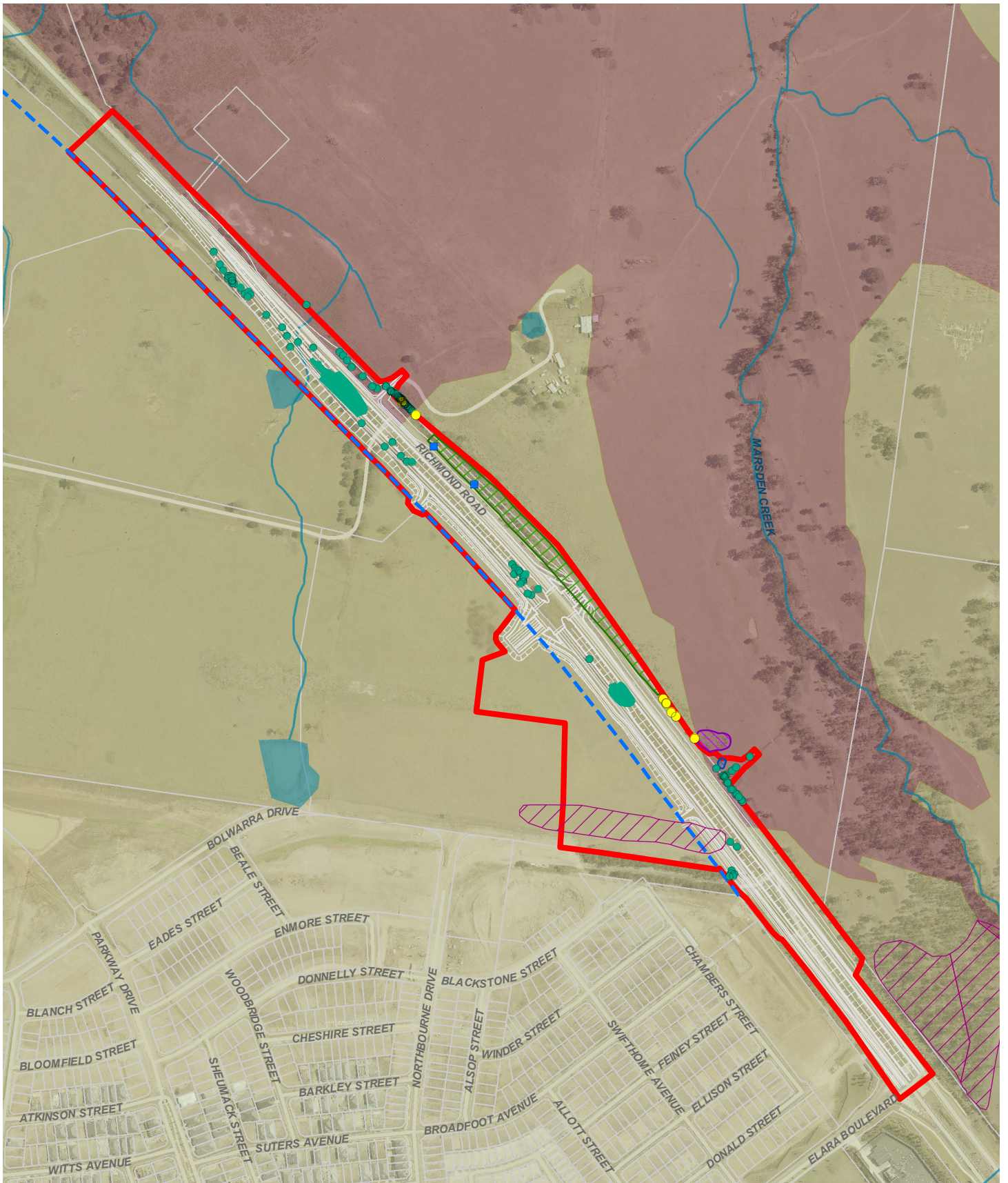
The Swift Parrot (listed as endangered under the BC Act and EPBC Act) has been recorded in the locality and sporadically occurs in the urbanised areas of western Sydney during winter. This species may pass through the study area during movements between larger foraging habitats (e.g. from vegetation patches east of Richmond Rd to Castlereagh Nature Reserve) where it may rest and forage in street trees or small vegetation remnants. Although no significant areas of foraging habitat are present, the Swift Parrot is considered moderately likely to occur in the study area on occasion. Likewise, the Little Lorikeet is also likely to use the trees in the study area, in a similar manner, as foraging habitat.

The Dusky Woodswallow, is likely to fly over the study area on occasion. However, the study area is considered unlikely to form suitable breeding habitat for this species and habitat use would be intermittent and minimal.

Table 3-3 Threatened fauna considered moderately or highly likely to occur, and area of direct disturbance (non-certified areas)

Species / community	BC Act	EPBC Act	Habitat in study area (hectares)
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	E	-	1.38
Dusky Woodswallow (<i>Artamus cyanopterus cyanopterus</i>)	V	-	1.38
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	-	1.38
Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>)	V	-	1.38
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	1.38
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	0.14
Large Bentwing-bat (<i>Miniopterus orianae oceanensis</i>)	V	-	1.38
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	1.38

Species / community	BC Act	EPBC Act	Habitat in study area (hectares)
Little Bent-wing Bat (<i>Miniopterus australis</i>)	V	-	1.38
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	0.14
Southern Myotis (<i>Myotis macropus</i>)	V	-	1.38
Swift Parrot (<i>Lathamus discolor</i>)	E	CE	0.14



Legend

- ▬ Construction footprint
- - - Proposed future road reserve boundary
- Proposed road design
- Watercourse
- Waterbody
- Mix of mature, native tree species (foraging habitat)
- Mix of mature, native tree species (foraging habitat)

- 500+ *Grevillea juniperina* subsp. Juniperina individuals
- 20+ *Grevillea juniperina* subsp. Juniperina individuals
- 50+ *Grevillea juniperina* subsp. Juniperina individuals
- *Grevillea juniperina* subsp. Juniperina individual
- Cumberland Plain Land Snail individuals

- Land certification (SEPP (Sydney Region Growth Centres) 2006)
- Certified
 - Non-certified
 - Existing Native Vegetation

0 150 300 m



1:7,000 at A4

Data sources

Jacobs 2020
 Ausimage 2018
 NSW Spatial Services 2020
 GDA94 MGA56

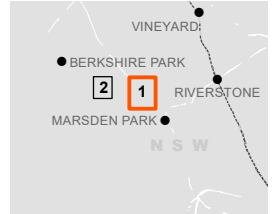
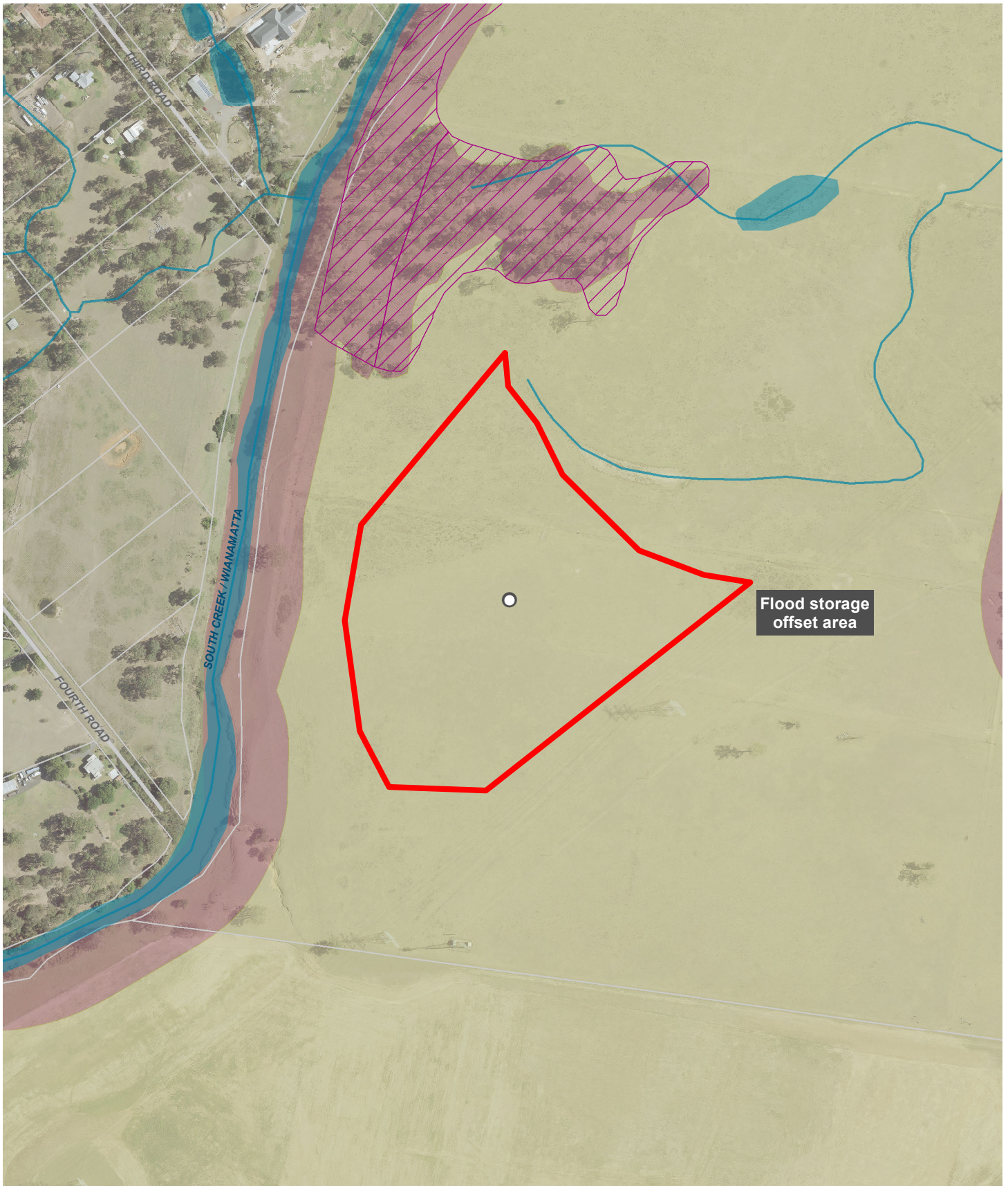
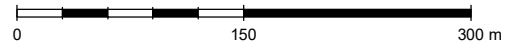


Figure 3-2.1 Biodiversity constraints on site



Legend

- ▬ Construction footprint
- ▬ Proposed road design
- ▬ Watercourse
- ▬ Waterbody
- ▬ Land certification (SEPP (Sydney Region Growth Centres) 2006)
- ▬ Certified
- ▬ Non-certified
- ▬ Existing Native Vegetation



1:5,000 at A4

Data sources

- Jacobs 2020
- Ausimage 2018
- NSW Spatial Services 2020
- GDA94 MGA56

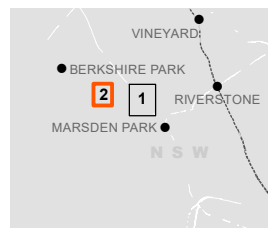


Figure 3-2.2 Biodiversity constraints on site

3.7 Aquatic results

The proposal lies within the South Creek catchment area. The hydrological environment of the study area is limited to an unnamed creek (Strahler 1st order stream) that was dry at the time of inspection. The creek within the study area is not a Type 1, Type 2 or Type 3 sensitive key fish habitat. There are no Class 1 (major key fish habitat), Class 2 (moderate key fish habitat) or Class 3 (minimal key fish habitat) waterways in the study area.

There is a lack of permanent flow, rubbish accumulation, weed proliferation, and evidence of physical disturbance. As such, the creek is in a moderately to highly degraded condition. The creek is not suitable for threatened aquatic species.

3.8 Wildlife connectivity corridors

The barrier posed by Richmond Road already serves to restrict fauna movements between habitat patches for terrestrial and arboreal species. However, the permeability of landscapes for different fauna species varies and habitat connectivity for more mobile species (e.g. birds, flying-foxes, insectivorous bats, insects, plants) remains. However, connectivity for sedentary species and smaller species such as the Cumberland Plain Land Snail, frogs and reptiles is likely to be minimal.

The roadways and urban areas do not totally prevent fauna movement between habitat fragments. Fauna can, and likely do, cross the road and disturbed areas of habitat but would do so less frequently than in natural habitats and would be at greater risk of mortality during movements. It is likely that animals move between vegetation patches to the east of Richmond Rd and Castlereagh Reserve despite the level of fragmentation that has occurred.

3.9 Matters of National Environmental Significance

3.9.1 Threatened ecological communities

The Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) identified, on certified land in the study area, is associated with Critically Endangered Ecological Communities under the BC Act. However, the patch of this PCT in the study area does not meet the key diagnostic features and condition thresholds to qualify as a listed ecological community under the EPBC Act.

3.9.2 Threatened species

Two threatened species listed under the EPBC Act are considered moderately likely to use the habitats in the study area for foraging: The Swift Parrot (listed as critically endangered) and the Grey-headed Flying-fox (listed as vulnerable).

The Grey-headed Flying-fox is considered moderately likely to forage on the blossoms of the mature, native trees within the study area on occasion, particularly *Eucalyptus moluccana*. No roost camps are present in the study area but the bats from the Ropes Crossing, Emu Plains, Yarramundi and Penrith camps are moderately likely to forage in the study area on occasion.

The Swift Parrot (listed as Endangered under the BC Act and Critically Endangered under the EPBC Act) has been recorded in the locality and sporadically occurs in the urbanised areas of western Sydney during winter. This species may pass through the study area during movements between larger foraging habitats (e.g. from vegetation patches east of Richmond Rd to Castlereagh Nature Reserve) where it may rest and forage in street trees or small vegetation remnants. Although no significant areas of foraging habitat are present, the Swift Parrot is considered moderately likely to occur in the study area on occasion.

3.9.3 Migratory species

Sixteen terrestrial migratory bird species were identified in the EPBC Act Protected Matters Search Tool as potentially occurring in the locality based on the distributional range of the species and modelled habitat. These migratory species (excluding those found in aquatic habitat), along with their preferred habitat requirements and an assessment of their likely presence in the study area are listed in Appendix B. Only the Fork-tailed Swift and White-throated Needle-tail are considered moderately likely to fly over the study area but would not use it as habitat.

While some migratory species of bird are likely use the study area and locality, the study area would not be classed as an 'important habitat'. A nationally significant proportion of the population would not be supported by the study area, as the habitats are not large enough or high enough quality. The proposal would not substantially modify, destroy or isolate an area of important habitat for the migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds.

4. Impact assessment

The proposal's likely direct and indirect impacts on biodiversity are summarised in this chapter. The assessment of direct impacts is based on the project design footprint, which includes a likely construction buffer factored into the design. The indirect impacts are discussed and the potential for indirect impacts on biodiversity values is considered low given that much of the adjoining lands are already cleared and modified and highly fragmented, as well as bordered by existing roads and barriers.

4.1 Construction impacts

4.1.1 Removal of native vegetation

The proposal would have direct and indirect impacts on a small range of biodiversity values during construction and operation. The proposal will require removal of:

about 0.83 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered ecological community (CEEC) under the BC Act within certified land ([Table 4-2](#))

about 0.27 hectares of native tree species (*Eucalyptus moluccana*, *Eucalyptus crebra*, *Acacia decurrens*, *Eucalyptus amplifolia*, *Angophora floribunda*, *Eucalyptus tereticornis* and *Casuarina cunninghamiana*) in certified land ([Table 4-2](#))

about 500 specimens of threatened Juniper-leaved Grevillea on certified land

0.14 hectares of mix of mature, native tree species (*Eucalyptus moluccana*, *Eucalyptus amplifolia*, *Angophora floribunda*, *Melaleuca decora* and *Eucalyptus tereticornis*) within non-certified land comprising potential foraging habitat for listed threatened species ([Table 4-1](#)).

About 20 specimens of threatened Juniper-leaved Grevillea within non-certified land.

About 1.38 hectares of highly disturbed exotic vegetation within non-certified land

In total, 0.14 hectares of native vegetation would be cleared in non-certified areas and 1.10 hectares of native vegetation in certified areas.

Table 4-1: Impacts on vegetation in non-certified areas

Vegetation description	Condition class	BC Act	EPBC Act	Study area (hectares)
Not assigned to PCT, comprises non-native highly disturbed areas – cleared paddocks, road verges, table drains, road embankments, ploughed paddocks etc	-	-	-	1.38
Mix of mature, native tree species (<i>Eucalyptus moluccana</i> , <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Melaleuca decora</i> and <i>Eucalyptus tereticornis</i>)	-	-	-	0.14

Table 4-2: Impacts on vegetation in certified areas

Vegetation description	Condition class	BC Act	EPBC Act	Study area (hectares)
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) (Critically Endangered Ecological Community (BC Act): Cumberland Plain Woodland in the Sydney Basin Bioregion)	Moderate/good	CEEC	-	0.83
Not assigned to PCT, comprises non-native highly disturbed areas – cleared paddocks, road verges, table drains, road embankments, ploughed paddocks etc	-	-	-	21.59 (includes off-site flood storage area)

Vegetation description	Condition class	BC Act	EPBC Act	Study area (hectares)
Mix of mature, native tree species (<i>Eucalyptus moluccana</i> , <i>Eucalyptus crebra</i> , <i>Acacia decurrens</i> , <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Eucalyptus tereticornis</i> and <i>Casuarina cunninghamiana</i>)	-	-	-	0.27

4.1.2 Removal of threatened fauna habitat

The extent of vegetation clearing estimated to result from the proposal is outlined above in Section 4.1.1. This vegetation provides suitable occasional foraging habitat for a range of highly mobile threatened fauna species listed under the BC Act and EPBC Act. As such, direct impacts to habitat for threatened fauna species (although it is poor quality) would occur during construction. This represents a relatively small area of habitat in relation to the extent of habitat available.

The proposal would impact habitat of the threatened Cumberland Plain Land Snail found on certified land in the remnant of the Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) within the study area. Comparable habitats were not found on the non-certified lands. The direct impacts of the proposal to threatened plant species and habitat of threatened species has been estimated based on the current design. A breakdown of the direct impacts to habitat for threatened fauna species is provided in [Table 4-3](#).

Table 4-3: Impacts on threatened species and fauna habitat in non-certified areas

Species / community	BC Act	EPBC Act	Habitat in study area (hectares) (non-certified areas)
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	E	-	1.38
Dusky Woodswallow (<i>Artamus cyanopterus cyanopterus</i>)	V	-	1.38
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	-	1.38
Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>)	V	-	1.38
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	1.38
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	0.14
Large Bentwing-bat (<i>Miniopterus orianae oceanensis</i>)	V	-	1.38
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	1.38
Little Bent-wing Bat (<i>Miniopterus australis</i>)	V	-	1.38
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	0.14
Southern Myotis (<i>Myotis macropus</i>)	V	-	1.38
Swift Parrot (<i>Lathamus discolor</i>)	E	CE	0.14

4.1.3 Removal of threatened flora

The proposal would potentially impact 20 individuals of the threatened plant species *Grevillea juniperina* subsp. *juniperina*, located on non-certified land, in the study area. Within certified land, the proposal would potentially impact 500+ *Grevillea juniperina* subsp. *juniperina* individuals. In terms of the broader local population of *Grevillea juniperina* subsp. *juniperina*, an estimated additional 100 individuals occur north of the study area on property DP715318 outside of the study area. No other individuals of *Grevillea juniperina* subsp. *juniperina* were detected in the study area. The loss of plants from the certified areas is considered large in the context of the local population, although a formal assessment of significance is not required because this area falls within certified lands. A summary of the direct impacts to threatened flora species is provided in [Table 4-4](#).

Table 4-4: Impacts on threatened flora in non-certified areas

Species / community	BC Act	EPBC Act	Habitat in study area (hectares) (non-certified areas)
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	V	-	20 plants

4.1.4 Aquatic impacts

An assessment of the potential presence of threatened fish species in the study area is provided in Appendix B. This assessment concludes that no threatened species listed under the FM Act are considered likely to occur due to the poor condition and lack of characteristic habitat features associated with the aquatic habitat present.

As discussed in Section 3.6, the aquatic habitat in the study area is limited to an unnamed stream (Strahler 1st order stream) with intermittent flow following rain events with little or no defined drainage channel. The creek within the study area is not a Type 1, Type 2 or Type 3 sensitive key fish habitat. There are no Class 1 (major key fish habitat), Class 2 (moderate key fish habitat) or Class 3 (minimal key fish habitat) waterways in the study area. As such, there would be no impacts to sensitive or key fish habitats.

Flood modelling (provided in Appendix K of the REF) indicates the raised road level, with incorporation of the flood storage offset area, will not result in a demonstrable change to the existing flood patterns. The upgraded section of road subject to the proposed works will incorporate drainage structures to control road runoff to the receiving ephemeral drainage lines. Open channels are incorporated in the proposal to divert external catchment runoff away from the road. The engineering risk of spill and pollution to South Creek was assessed as not warranting a permanent water quality treatment basin (refer Chapter 6.5 of the REF). Therefore, any potential change to water quality, resulting from the increased hard surfaces associated with the road upgrade, is not likely to have a demonstrable impact on the aquatic ecology of South Creek. Impacts to aquatic habitat would be of low magnitude and standard mitigation measures would be implemented to limit potential impacts (see Section 5).

4.1.5 Groundwater Dependant Ecosystems

The Atlas of Groundwater Dependent Ecosystems (Bureau of Meteorology, 2017) identified no groundwater dependent terrestrial vegetation in the study area. The study area does not contain any aquatic or subterranean GDEs.

The proposal is not considered likely to intersect groundwater during construction given the shallow excavation required for the flood offset area and the amount of filling required for the road construction.

4.1.6 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 microchiropteran bat 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 injured or killed during vegetation removal. This is because there is a notable absence of hollow-bearing trees. Reptiles and frogs may also be injured or killed 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 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 relates to the physical dividing up of once continuous habitats into separate smaller 'fragments' (Fahrig, 2002). Further habitat fragmentation is unlikely to occur from the proposal as the work would largely involve removing vegetation from patch edges, in the road reserve, rather than breaking apart of large blocks of vegetation into many smaller patches. Importantly, the proposal would not result in the breaking apart of large blocks of high-quality habitats. No further habitat fragmentation on a landscape scale would occur because of the proposal. Isolation of habitats is likely to increase by a small extent as the distance between patches on either side of road would be increased. However, functional habitat connectivity for more mobile species (e.g. birds, flying-foxes, insectivorous bats, 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 predicted level of isolation from the 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 mitigation measures are not deemed necessary.

4.2.2 Edge effects on adjacent native vegetation and habitat

The development of linear infrastructure is known to cause disturbance in terms of reducing habitat quality in adjacent areas. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. The proposal would be

built in an area that is currently subject to a high level of edge effects from the existing roadways and urban development. The vegetation patches are suffering from intense weed invasion and the habitats that would be impacted by the proposal are edge habitats without any undisturbed core. There is unlikely to be any further impacts from edge effects resulting from the proposal as all vegetation is suffering from edge effects in the form of weed invasion, increased light levels, increased wind speeds, and greater temperature fluctuations. No new edge habitats would be created as the study area does not possess large core areas of undisturbed habitat.

This impact would be of low magnitude and 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 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 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.

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 pest species including rabbits. Proposal activities have the potential to disperse pest species out of the proposal footprint 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

Several pathogens known from NSW have potential to impact on biodiversity as a result their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- § Dieback caused by *Phytophthora* (Root Rot; EPBC Act and BC Act)
- § Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- § Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all proposal phases (construction and operation). Pathogens would be managed within the proposal site according to the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011b) (see Section 5).

4.2.6 Changes to hydrology

Flood modelling (provided in Appendix K of the REF) indicates the raised road level, with incorporation of the flood storage offset area, will not result in a demonstrable change to the existing flood patterns. The upgraded section of road subject of the proposal will incorporate drainage structures to control road runoff to downstream receiving watercourses. Open channels are incorporated in the proposal to divert external catchment runoff away from the road. The engineering risk of spill and pollution to South Creek was assessed as not warranting a permanent water quality treatment basin (refer Chapter 6.5 of the REF). Therefore, any potential change to water quality, resulting from the increased hard surfaces

associated with the road upgrade, is not likely to have a demonstrable impact on the aquatic ecology of South Creek.

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 Richmond 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 would be used at night to enable work to be completed that may result in impacts to nocturnal fauna. Common 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 Atlas of Groundwater Dependent Ecosystems (Bureau of Meteorology, 2017) identified no groundwater dependent terrestrial vegetation in the study area. The study area does not contain any aquatic or subterranean GDEs. The proposal is not considered likely to have operational impacts on GDEs or indirectly impact GDEs in the study area.

4.3 Cumulative impacts

The potential biodiversity impacts of the proposal must be considered as a consequence of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context.

The accumulating impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure would likely include continued loss of biodiversity on the Cumberland Plain. Within the project study area, the Hawkesbury - Nepean Channels and Floodplains Mitchell Landscape is an over cleared landscape with 79 per cent of native vegetation having been cleared. Only 21 per cent of the original native vegetation remains. The other Mitchell Landscape within the study area, the Hawkesbury - Nepean Terrace Gravels Mitchell Landscape is not classed as over-cleared, but 69 per cent of its native vegetation has been cleared. Only 31 per cent of the original native vegetation remains. Due to the likely expansion of western Sydney and creation of housing and associated infrastructure, further impacts to biodiversity are likely to result in this region.

While data from all recent projects in the locality is not freely available, some information on the likely biodiversity impacts from recent projects is available as follows:

- § Rezoning of the Kellyville Precinct, is anticipated to impact on about 5.42 ha of vegetation from threatened ecological communities and 1.93 ha of riparian corridor vegetation (Eco Logical, 2014).
- § The construction footprint of the M4 Managed Motorway project is anticipated to impact on about 31.25 hectares of planted and remnant vegetation in various states of condition. This area of clearing includes 3.82 hectares of remnant vegetation (Jacobs, 2015).

- § Honeman Close SIS indicates that approximately 4.5 hectares of native vegetation would be removed from Lot 2 DP 229466 (Cumberland Ecology, 2017)
- § Great Western Highway and Reservoir Road Intersection Upgrade Biodiversity Assessment indicates that approximately 0.48 hectares of threatened ecological communities would be removed (Jacobs, 2018).

When considered together, these projects combine to remove approximately 16.15 ha of remnant native vegetation from the Cumberland Plain, including 6 ha from threatened ecological communities. This is a large cumulative impact in terms of the over-cleared landscape of the region. The impacts from the current proposal add 0.14 ha of vegetation clearance to the region-wide vegetation clearance that has occurred across the Cumberland Plain. However, given this vegetation is highly fragmented, low quality, and does not represent a recognised PCT, the proposed vegetation clearance is not considered to significantly impact the regional landscape or this particular community.

4.4 Assessments of significance

An Assessment of Significance has been conducted for threatened species 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. Assessment of significance is not required for any area of Threatened Ecological Community (TEC), as there are no areas of TEC within the non-certified portion of the study area.

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

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 4-4](#), which indicates that a significant effect is considered unlikely on any threatened species listed under the BC Act (no threatened ecological communities are present in the study area).

The assessment of impacts on the vulnerable species *Grevillea juniperina subsp. juniperina*, is complicated because of the presence of the different zones mapped under the Sydney Growth Centres SEPP 2006. The largest proportion of the population occurs within certified land where the impact would equate to potentially 500 individuals, is a significant proportion of the site population (around 80-90 per cent) and may typically constitute a significant impact. However, the Biodiversity Certification Order provides that any developments or activities proposed to be undertaken within certified areas do not need to undertake assessment of impacts on threatened species, populations and ecological communities, or their habitats, that would normally be required by Parts 3, 4 or 5 of the EP&A Act. The impact on *Grevillea juniperina subsp. juniperina* in the non-certified lands is around 20 plants or 3 per cent of the site population. In context, this impact assessment on its own merit, has been assessed as not significant. While there is no legislative obligation to assess the loss of 500 plants from the certified lands, the cumulative impact on the population should be the focus of the project mitigation strategy with intent to avoid and minimise this impact as much as possible.

For threatened biodiversity listed under the EPBC Act, considered likely to occur within the non-certified land, 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 proposal would not be required (see [Table 4-5](#)). Full details of the assessment of significance for threatened species under the EPBC Act are presented in Appendix C.

Table 4-4 Summary findings of the BC Act test of significance

Biodiversity Conservation Act 2016 test of significance						
Threatened species, or communities	Significance assessment question ¹					Likely significant effect?
	a	b	c	d	e	
Juniper-leaved Grevillea (<i>Grevillea juniperina</i> subsp. <i>juniperina</i>)	N	X	N	N	Y	No
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	N	X	Y	N	Y	No
Dusky Woodswallow (<i>Artamus cyanopterus cyanopterus</i>)	N	X	N	N	Y	No
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	N	X	N	N	Y	No
Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>)	N	X	N	N	Y	No
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	N	X	N	N	Y	No
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	N	X	N	N	Y	No
Large Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	N	X	N	N	Y	No
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	N	X	N	N	Y	No
Little Bent-wing Bat (<i>Miniopterus australis</i>)	N	X	N	N	Y	No
Little Lorikeet (<i>Glossopsitta pusilla</i>)	N	X	N	N	Y	No
Southern Myotis (<i>Myotis macropus</i>)	N	X	N	N	Y	No
Swift Parrot (<i>Lathamus discolor</i>)	N	X	N	N	Y	No

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.

Table 4-5: Summary findings of the EPBC Act significance assessments

Species/Ecological Community	*Assessment of significance questions (EPBC Act) ¹									Important Population +	Likely Significant Impact	
	1	2	3	4	5	6	7	8	9			
Vulnerable species												
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	N	N	N	N	N	N	N	N	N	N	Yes	No
Critically Endangered species												
Swift Parrot (<i>Lathamus discolor</i>)	N	N	N	N	N	N	N	N	N	N	NA	No

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

1. An action is likely to have a significant impact on a vulnerable, 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 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 the predicted ecological impacts from the proposal is provided in [Table 4-6](#).

Table 4-6: Summary of potential impacts

Impact	Biodiversity values	Nature of impact	Extent of impact (non-certified areas)	Duration	Does the proposal constitute or exacerbate a key threatening process?
Removal of native vegetation	Native vegetation	Direct	0.14 hectares of foraging habitat (mix of mature, native tree species)	Permanent	Clearing of native vegetation
Removal of threatened fauna habitat	Cumberland Plain Land Snail	Direct	1.38 hectares	Permanent	Clearing of native vegetation
	Dusky Woodswallow	Direct	1.38 hectares	Permanent	Clearing of native vegetation

Impact	Biodiversity values	Nature of impact	Extent of impact (non-certified areas)	Duration	Does the proposal constitute or exacerbate a key threatening process?
	Little Lorikeet, Swift Parrot	Direct	0.14 hectares of foraging habitat (mix of mature, native tree species)	Permanent	Clearing of native vegetation
	Little Bent-wing Bat, Large Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Southern Myotis, Greater Broad-nosed Bat, Large-eared pied-bat	Direct	1.38 hectares	Permanent	Clearing of native vegetation
	Grey-headed Flying-fox	Direct	0.14 hectares of foraging habitat (mix of mature, native tree species)	Permanent	Clearing of native vegetation
Removal of threatened flora	Juniper-leaved Grevillea	Direct	twenty potentially removed	Permanent	Clearing of native vegetation
Aquatic impacts	Aquatic fauna	Direct	Only poor-quality habitat to be affected	Long term	-
Injury and mortality of fauna		Direct	Unknown. Impact cannot be quantified	Long term	-
Fragmentation of identified biodiversity links and habitat corridors	Flora and fauna species present in the habitat	Direct/indirect	Minimal, but local habitat isolation would be increased	Long term	-
Edge effects on adjacent native vegetation and habitat	Flora and fauna species present in the habitat	Indirect	Minimal as no core habitat is present	Long term	-
Invasion and spread of weeds	Flora and fauna species adjacent the study area	Indirect	Without appropriate management strategies, proposal activities have the potential to disperse weeds	Long term	Invasion and establishment of exotic vines and scramblers Invasion of native plant communities by African Olive (<i>Olea europaea</i> L. subsp. <i>cuspidata</i>) Invasion, establishment and spread of <i>Lantana camara</i> Invasion of native plant communities by exotic perennial grasses
Invasion and spread of pests	Flora and fauna species present in the habitat	Indirect	The study area is currently habitat for a range of pest species.	Long term	Competition and grazing by the feral European rabbit (<i>Oryctolagus cuniculus</i>)

Impact	Biodiversity values	Nature of impact	Extent of impact (non-certified areas)	Duration	Does the proposal constitute or exacerbate a key threatening process?
					Predation by the European red fox (<i>Vulpes vulpes</i>)
Invasion and spread of pathogens and disease	Flora and fauna species present in the habitat	Indirect	While pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction	Long term	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 of frogs by amphibian chytrid causing the disease chytridiomycosis
Noise, light and vibration	Flora and fauna species present in the habitat	Direct/ indirect	There would be an impact from noise, light and vibration but the level of noise, vibration and light spill into adjacent habitats during construction and operation cannot be quantified	Short term	-

5. Avoid, minimise and mitigate impacts

In managing biodiversity, Transport for NSW 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 particular environmental consequences of an activity, recognising that achieving an optimal outcome often requires compromise and decisions regarding environmental values. A key part of Transport for NSW's management of biodiversity for this 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 particular 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 first priority is to avoid impacts to the environment. This can be achieved by early consideration of environmental issues from identification of constraints at project 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.

A REF scoping checklist was prepared during the early stages of concept design development which identified the likely presence of the Vulnerable species *Grevillea juniperina* subsp. *juniperina* and Endangered Cumberland Plain Land Snail. As such, a project REF was deemed to be the best approach for assessment. There is minimal opportunity for proposal alternatives or designs due to the location of the road and intended outcomes of the proposal. While there is no legislative obligation to assess the loss of 500 plants from the certified lands, the cumulative impact on the population should be considered in the project mitigation strategy with intent to avoid and minimise this impact as much as possible.

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). Proposal compound sites and the off-site flood storage area have been proposed in highly disturbed areas to avoid impacts to biodiversity. Design refinements would be undertaken in the detailed design phase to reduce the scope of the overall impact to biodiversity.

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 proposal. Mitigation measures are to be undertaken during the construction and operational phases. The Transport for NSW 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, 2011a) are recommended for implementation (see [Table 5-1](#)).

Table 5-1: Proposed mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	Native vegetation removal would be minimised through detailed design.	Detailed design	Effective	The predicted residual impact to threatened species habitat is an estimated 0.14 hectares of foraging habitat (mix of mature, native tree species)
	Pre-clearing surveys would be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Prior to construction	Effective	
	Vegetation removal would be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Effective	
	Exclusion zones would be set up at the limit of clearing (i.e. the edge of the impact area) in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Before construction	Effective	
Removal of threatened species habitat and habitat features	Habitat removal would be minimised through detailed design.	Detailed design	Effective	The predicted residual impact to threatened species habitat is an estimated 0.14 hectares of foraging habitat (mix of mature, native tree species)
	Habitat removal would be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	
	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 fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
Removal of threatened plants	Pre-clearing surveys would 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	The loss and disturbance of <i>Grevillea juniperina</i> subsp. <i>juniperina</i> plants would be minimised.
	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 proposal site.	During construction	Proven	
	Any plants in proximity to the construction footprint should be considered during detailed design and avoided where possible, this is specific to the non-certified lands, however given the potentially large loss of plants from the certified areas, it would also be appropriate to minimise the loss of plants. Physically mark plants that will not be directly impacted, but close to the construction footprint, prior to construction, particularly at site proposed for	During construction	Proven	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	culvert construction inside non-certified land. If exclusion fence is used, erect signs to inform personnel of the purpose of exclusion zone fencing. Maintenance of exclusion fencing until the risk to disturbance within the excluded zone has been eliminated through other means. Communicate the importance of exclusion zones, and any changes to the zones, to all site staff and visitors (e.g. in toolbox talks and inductions). Reporting of any breaches of the exclusion zone through the Transport for NSW environmental incident reporting procedure.			
	Seed collection, propagation and replanting of <i>Grevillea juniperina</i> subsp. <i>juniperina</i> plants impacted by proposal.	During construction	Effective	
Aquatic impacts	Aquatic habitat would 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 Section 3.3.2 <i>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.
Groundwater dependent ecosystems	No specific measures are considered necessary as there are no GDEs in the study area	Detailed design	Effective	As per PCT impacts
Fragmentation of identified habitat corridors	No specific measures are considered necessary as no further increase to fragmentation would occur.	Detailed design, during construction and post construction	Effective	No residual impact is anticipated
Edge effects on adjacent native vegetation and habitat	Exclusion zones would 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
Injury and mortality of fauna	Fauna would 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
Invasion and spread of weeds	Weed species would 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
Invasion and spread of pests	Pest species would be managed within the proposal site.	During construction	Effective	None expected

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Invasion and spread of pathogens and disease	Pathogens would be managed in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Noise, light and vibration	Shading and artificial light impacts would be minimised through detailed design.	Detailed design	Effective	Impacts from noise and light spill would remain

6. Offset strategy

6.1 Quantification of impacts

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur. This biodiversity assessment identifies that the 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 C). In this instance, and due to the Commonwealth Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

Under the Growth Centres SEPP, according to the Guide to Biodiversity Certification (Department of Planning 2009), if existing native vegetation (ENV) within non-certified lands is proposed to be cleared for development, the Department of Planning, Industry and Environment must demonstrate that this will be offset by protecting an equal or greater area of existing native vegetation elsewhere in the Growth Centres. No ENV will be impacted within non-certified lands by the proposal and no ENV offset is required under the Growth Centres SEPP.

The project will require removal of the following:

Around 0.83 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion (listed as Critically Endangered Ecological Community under the BC Act) within certified land which has already been offset under the provisions of the Sydney Growth centre SEPP 2006.

Around 0.84 hectares of *Grevillea juniperina* subsp. *juniperina* (vulnerable species - BC Act) , including around 0.83 hectares (500+ individuals) in certified lands, mapped under the Sydney Growth Centres SEPP 2006 and 0.1 hectares (20+ individuals) impacted within non-certified land.

In accord with the Transport for NSW biodiversity offset policy (Roads and Maritime Services 2016), Transport would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in [Table 6-1](#).

Table 6-1: Transport for NSW offset thresholds and relevance to project

Description of activity or impact	Consider offsets or supplementary measures	Project relevance
Activities in accordance with Transport for NSW Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	NA
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	NA
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	NA

Description of activity or impact	Consider offsets or supplementary measures	Project relevance
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	Around 0.83 hectares will be removed, however this falls within certified land, which has already been offset in accordance with the Growth Centres SEPP
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 hectare of a TEC or habitat in moderate to good condition	NA
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 hectares or where the ecological community is subject to an SIS	NA
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 > 1 hectares or where the species is the subject of an SIS	<i>Grevillea juniperina</i> subsp. <i>juniperina</i> a species credit species – impacts to around 0.84 hectares. Offsets not required.
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 > 5 hectares or where the species is the subject of an SIS	Cumberland Plain Snail (BC Act), impacts to around 1.38 hectares – offsets not required
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	NA

The Transport for NSW *Guideline for Biodiversity Offsets* (November 2016) indicates that offsets are to be considered where there is any clearing of NSW listed critically endangered ecological communities in moderate to good condition. However, there is no offset in this instance as the BC Act listed Cumberland Plain Woodland in the Sydney Basin Bioregion critically endangered ecological community is on certified land and does not qualify for offsets in [Table 6-1](#).

The proposal would also involve clearing of the BC Act listed *Grevillea juniperina* subsp. *juniperina* on non-certified and certified land in the study area. Individuals on certified land do not qualify for offsets in [Table 6-1](#). *Grevillea juniperina* subsp. *Juniperina* individuals on non-certified land in the study area also do not qualify for offsets, as the clearing of habitat for *Grevillea juniperina* subsp. *Juniperina* is not > 1 hectares ([Table 6-1](#)).

As well, the proposal would also involve clearing of individuals and habitat of the BC Act listed Cumberland Plain Land Snail. However, this habitat is on certified land and does not qualify for offsets in [Table 6-1](#).

While offsets are not required for the clearing of around 20 *Grevillea juniperina* subsp. *Juniperina*, specific mitigation measures have been provided to minimise the loss of individuals, and there is scope to do this during detailed design and construction. Supplementary measures should also be considered given the large number of plants to be removed from certified areas. This could include seed collection, propagation and replanting.

6.2 Biodiversity Offset strategy

This biodiversity assessment identifies that the 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 C). In this instance, and due to the Commonwealth Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

7. Conclusion

The Study Area consists of land certified by the Western Sydney Growth Centres Order 2007 under the then TSC Act associated with the Marsden Park urban development precinct under SEPP (Sydney Growth Centres) 2006. About 0.83 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered ecological community (CEEC) under the BC Act located within certified land will be affected by the proposal. Clearing of listed CEEC or species within the certified land does not need further biodiversity assessment under BC Act and EPBC Act. Therefore, impacts on land found on certified land were not considered further in this REF.

The remainder of vegetated areas are classed as highly disturbed areas – cleared paddocks, road verges, table drains, road embankments etc. (this includes the proposed compound site and off-site flood storage area).

No threatened ecological communities (TECs) listed under the BC or EPBC Acts were identified in the non-certified area of the study area.

One threatened flora species under BC Act was recorded in the study area during the field survey undertaken for the proposal Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*). This included twenty specimens on non-certified land near the property boundary of DP715318 north of Richmond Rd and 500+ on certified land also near the property boundary of DP715318 north of Richmond Rd. Impacts on specimens found on certified land were not assessed in this REF. The impact of clearing about 0.01 hectares (20+ individuals) of the threatened Juniper-leaved Grevillea on non-certified land is assessed as being not significant.

The following species are either known to occur in adjacent habitat or are considered at least moderately likely to occur, on non-certified land, in the study area based on the presence of suitable habitat:

- § Cumberland Plain Land Snail (*Meridolum corneovirens*)
- § Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- § Little Lorikeet (*Glossopsitta pusilla*)
- § Swift Parrot (*Lathamus discolor*)
- § Little Bent-wing Bat (*Miniopterus australis*)
- § Large Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- § Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- § Eastern Freetail-bat (*Mormopterus norfolkensis*)
- § Southern Myotis (*Myotis macropus*)
- § Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- § Large-eared Pied Bat (*Chalinolobus dwyeri*)
- § Grey-headed Flying-fox (*Pteropus poliocephalus*)

The key impacts of the proposal include the removal of:

about 0.83 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion, listed as critically endangered ecological community (CEEC) under the BC Act within certified land

about 500 specimens of threatened Juniper-leaved Grevillea on certified land

about 0.27 hectares of native tree species in certified land ([Table 4-2](#))

0.14 hectares of mix of mature, native tree species native vegetation within non-certified land comprising potential foraging habitat for listed threatened species ([Table 4-2](#))

About 20 specimens of threatened Juniper-leaved Grevillea within non-certified land.

About 1.38 hectares of highly disturbed exotic vegetation within non-certified land

No vegetation mapped as Existing Native Vegetation in the SEPP Growth Centres would be impacted by the proposal.

Fauna injury or death has the greatest potential to occur during vegetation clearing, and the extent of this impact would be proportionate to the extent of vegetation that is cleared. Indirect / operational impacts including a minor increase in habitat isolation. Invasion and spread of weeds, invasion and spread of pests, and invasion and spread of pathogens and disease are a risk with a proposal of this type. Noise, light and vibration would be increased during construction and operation. Significant impacts to aquatic ecosystems are unlikely to occur as a result of the proposal.

The study area is situated in a cleared landscape due to historic activities. In the context of historic vegetation removal, any future vegetation clearing no matter how small would result in incremental cumulative impact that would detrimentally affect biodiversity. The proposal would contribute to cumulative biodiversity impacts, by a small, not significant amount.

Mitigation measures described in Section 5 would be implemented during the construction and operational phases to lessen the potential ecological impacts of the proposal. Transport for NSW *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011a) identify a range of mitigation techniques to be applied and these techniques must be implemented during construction. Due to the presence of threatened *Grevillea juniperina* subsp. *juniperina* plants and a critically endangered ecological community, exclusion zones would be established to delineate the works limit boundary to ensure no accidental impacts occur.

Since the 0.01 hectares clearing of the BC Act listed *Grevillea juniperina* subsp. *juniperina* will not exceed 5 hectares (within non-certified land), the environmental offsets policy, under the Transport for NSW *Guideline for Biodiversity Offsets* (Roads and Maritime Services, 2016), does not apply. Despite this, there will be a larger impact to this species within the certified land, that is already approved to be cleared pursuant to the order certifying land within the Growth Centres SEPP. Given the likelihood of a cumulative impact on this species, a mitigation strategy is considered appropriate, and should include avoidance of plants where possible, seed collection, propagation and replanting.

In the context of the proposed development and considering only impacts to non-certified land under the Growth Centres SEPP, the biodiversity assessment concludes that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act.

8. References

- BUREAU OF METEOROLOGY. 2017. *Atlas of Groundwater Dependent Ecosystems* [Online]. Available: <http://www.bom.gov.au/water/groundwater/gde/> [Accessed May 2020].
- CHURCHILL, S. 2008. *Australian Bats*, Sydney, Allen & Unwin.
- CLARKE, N. R. & JONES, D. C. 1991. *Penrith 1:100 000 Geological Sheet 9030*. Sydney: Geological Survey of New South Wales.
- COGGER, H. G. 2000. *Reptiles and Amphibians of Australia*, Sydney, Reed Books.
- COURTNEY, J. & DEBUS, S. 2006. Breeding habits and conservation status of the Musk Lorikeet *Glossopsitta concinna* and Little Lorikeet *G. pusilla* in Northern New South Wales. *Australian Field Ornithology*, 23, 109-124.
- CUMBERLAND ECOLOGY 2017. Honeman Close Huntingwood Species Impact Statement, prepared for ADW Johnson. Carlingford Court.
- DEPARTMENT OF ENVIRONMENT 2013. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Canberra, ACT: Commonwealth of Australia.
- DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. Descriptions for NSW (Mitchell) Landscapes Version 2 (2002) Sydney: Department of Environment and Climate Change.
- DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2004. Green and Golden Bell Frog environmental impact assessment guidelines Hurstville: Department of Environment and Conservation (NSW).
- DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2005. Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*). Hurstville, NSW: Department of Environment and Conservation (NSW).
- DEPARTMENT OF ENVIRONMENT CLIMATE CHANGE AND WATER 2009. Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Sydney: Department of Environment, Climate Change and Water.
- DEPARTMENT OF THE ENVIRONMENT AND ENERGY. 2017. *Finalised priority assessment lists* [Online]. Canberra: Australian Government. Available: <http://www.environment.gov.au/biodiversity/threatened/assessments/fpal> [Accessed 14/11/2017].
- DEPARTMENT OF THE ENVIRONMENT, W., HERITAGE AND THE ARTS 2010. Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. A guide to identifying and protecting the nationally threatened ecological community.
- ECO LOGICAL 2014. Kellyville Precinct – Ecological Constrains Assessment.
- FAHRIG, L. 2002. Effects of habitat fragmentation on the extinction threshold: a review. *Ecological Applications*, 12, 346-352.
- FAIRFULL, S. & WITHERIDGE, G. 2003. Why do fish need to cross the road? Fish passage requirements for waterway crossings. Cronulla: NSW Fisheries.
- GARNETT, S. T. & CROWLEY, G. M. 2000. *The Action Plan for Australian Birds*, Canberra, Environment Australia.
- HARDEN, G. 1992. *Flora of New South Wales Volume 3*, Kensington, University of New South Wales Press Ltd.
- HARDEN, G. 2002. *Flora of New South Wales Volume 2 (Revised Edition)*, Kensington, University of New South Wales Press Ltd.
- HAZELTON, P. A., BANNERMAN, S. M. & TILLIE, P. J. 1989. *Soil landscapes of the Penrith 1:100000 Sheet 9030*. Soil conservation Service of NSW, Sydney. .
- HIGGINS, P. J. (ed.) 1999. *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds*, Melbourne: Oxford University Press.
- HIGGINS, P. J. & PETER, J. M. (eds.) 2002. *Handbook of Australian, New Zealand and Antarctic Birds*, Melbourne: Oxford University Press.
- JACOBS 2015. M4 Smart Motorway Biodiversity Assessment Sydney: Jacobs.
- JACOBS 2018. Great Western Highway and Reservoir Road Intersection Upgrade Biodiversity Assessment.
- KUGINIS, L., BYRNE, G., SEROV, P. & WILLIAMS, J. P. 2012. Risk assessment guidelines for groundwater dependent ecosystems, Volume 3 – Identification of high probability groundwater dependent

- ecosystems on the coastal plains of NSW and their ecological value. Sydney: NSW Department of Primary Industries, Office of Water.
- MARCHANT, S. & HIGGINS, P. J. (eds.) 1993. *Handbook of Australian, New Zealand and Antarctic Birds Volume 2: Raptors to Lapwings*, Melbourne: Oxford University Press.
- MCKILLIGAN, N. 2005. *Hérons, egrets and bitterns: their biology and conservation in Australia*, Collingwood, Victoria, CSIRO Publishing.
- MORGAN, G. 2001. *Delineation and description of the Eastern Environmental Subregions (provinces) in New South Wales Study* [Online]. Hurstville: NSWNPWS. Available: <http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm> [Accessed].
- NPWS 2000. ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES Cumberland Plain Large Land Snail.
- NSW DEPARTMENT OF PLANNING, I. A. E. 2020. *Preliminary determinations by date* [Online]. NSW Government. Available: <http://www.environment.nsw.gov.au/committee/preliminarydeterminationsbydate.htm> [Accessed Page last updated: 20 March 2020].
- NSW DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update).
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 1999a. *Acacia bynoeana* threatened species information. Hurstville: NSW National Parks and Wildlife Service.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 1999b. Koala threatened species information. Hurstville: NSW National Parks and Wildlife Service.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 1999c. Spotted-tailed Quoll threatened species information. Hurstville: NSW National Parks and Wildlife Service.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 1999d. Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 2001a. Giant Burrowing Frog threatened species information. Hurstville: NSW National Parks and Wildlife Service.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 2001b. Grey-headed Flying Fox threatened species information. Hurstville: NSW National Parks and Wildlife Service.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE. 2002a. *Landscapes (Mitchell) of NSW*. Hurstville NSW National Parks and Wildlife Service.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 2002b. *Threatened Species of the Upper North Coast of New South Wales - Fauna*, Coffs Harbour, NSW National Parks and Wildlife Service, Northern Directorate.
- NSW NATIONAL PARKS AND WILDLIFE SERVICE 2003. Draft Recovery Plan for the Koala. Hurstville: NSW National Parks and Wildlife Service.
- NSW ROADS AND TRAFFIC AUTHORITY 2011a. Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. Sydney: NSW Roads and Traffic Authority.
- NSW ROADS AND TRAFFIC AUTHORITY 2011b. Protecting and managing biodiversity on RTA projects. Sydney: RTA Environment Branch.
- OFFICE OF ENVIRONMENT AND HERITAGE 2016. NSW Guide to Surveying Threatened Plants Sydney: NSW Office of Environment and Heritage.
- OFFICE OF ENVIRONMENT AND HERITAGE 2017a. Biodiversity Assessment Method. Sydney: State of New South Wales.
- OFFICE OF ENVIRONMENT AND HERITAGE. 2017b. *BioNet Vegetation Classification* [Online]. NSW Office of Environment and Heritage. Available: <http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx> [Accessed 08/08/2015].
- OFFICE OF ENVIRONMENT AND HERITAGE 2018. Threatened Species Test of Significance Guidelines.
- OFFICE OF ENVIRONMENT AND HERITAGE NSW 2011. Remnant Vegetation Mapping of the Cumberland Plain (crown cover less than 10%). VIS_ID 2222.
- PIZZEY, G. & KNIGHT, F. 1997. *Field Guide to the Birds of Australia*, Sydney, Harper and Collins.
- ROADS AND MARITIME SERVICES 2016. Guideline for Biodiversity offsets.

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- ROYAL AUSTRALIAN ORNITHOLOGISTS UNION 2003. *The New Atlas of Australian Birds*, Royal Australian Ornithologists Union, Hawthorn East, Victoria.
- SAUNDERS, D. L. & TZAROS, C. L. 2011. National Recovery Plan for the Swift Parrot *Lathamus discolor*. Melbourne: Birds Australia.
- STATE GOVERNMENT OF NSW AND OFFICE OF ENVIRONMENT AND HERITAGE 2010. Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230. Sydney.
- STATE OF NSW AND OFFICE OF ENVIRONMENT AND HERITAGE 2014. Framework for Biodiversity Assessment.
- STRAHAN, R. 1995. *The Mammals of Australia*, Sydney, Reed New Holland.
- SWIFT PARROT RECOVERY TEAM 2001. Swift Parrot Recovery Plan. In: DEPARTMENT OF PRIMARY INDUSTRIES, W. A. E. T. (ed.). Hobart: Department of Primary Industries, Water and Environment.
- THACKWAY, R. & CRESSWELL, I. D. 1995. *An Interim Biogeographic Regionalisation of Australia*, Canberra, Australian Nature Conservation Agency.
- TOZER, M., TURNER, K., SIMPSON, C., KEITH, D., BEUKERS, P., MACKENZIE, B., TINDALL, D. & PENNAY, C. 2006. Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands. Version 1.0. Hurstville: Department of Environment and Climate Change.

Appendix A – Species recorded

Recorded flora

Family	Scientific Name	Common name	Status		Abundance in each plot*	
			BC Act	EPBC Act	1	2
Adiantaceae	<i>Cheilanthes sieberi</i>	Mulga Fern			20	
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs				5
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle				2
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane			4	
Asteraceae	<i>Hypochaeris radicata</i>	Catsear				5
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce				2
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed				2
Asteraceae	<i>Sonchus oleracea</i>	Common Sowthistle				1
Asteraceae	<i>Taraxacum officinale</i>	Dandelion				4
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Early Green Wattle			2	
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	Hickory wattle			3	
Lamiaceae	<i>Mentha saturioides</i>	Creeping Mint			5	
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush			10	
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow				2
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne				12
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark			11	
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark			4	
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box			2	
Phormiaceae	<i>Dianella longifolia</i>	Blueberry Lily			4	

Pittosporaceae	<i>Bursaria spinosa</i>	Blackthorn			7	
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues				10
Poaceae	<i>Chloris gayana</i>	Rhodes Grass				300+
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass				50+
Poaceae	<i>Microlaena stipoides</i>	weeping grass			100	
Poaceae	<i>Paspalidium distans</i>				100	
Poaceae	<i>Paspalum dilatatum</i>	Paspalum				50+
Proteaceae	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>		V		50+	
Solanaceae	<i>Solanum sisymbriifolium</i>					
Verbenaceae	<i>Verbena bonariensis</i>	Purple top				8

Note: *Abundance should be determined in accordance with the FBA (State of NSW and Office of Environment and Heritage, 2014).

Vegetation condition assessment table

Site value	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Highly disturbed areas cleared paddocks, road verges, table drains, road embankments etc
Plot number:	1	2
Native plant species	14	0
Native overstorey cover (%)	23	0
Native midstory cover (%)	5	0
Native ground cover – grass (%)	11	0
Native ground cover – shrub (%)	2	0
Native ground cover – other (%)	1	0

Exotic plant cover (%)	2	100
Number of hollow trees	0	0
Canopy Regeneration (%)	100	0
Fallen logs (m)	0	0
Total score	33.3	0
Condition category	Moderate to good condition	Low

Appendix B – Habitat assessment table

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 a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Habitat assessment table – Threatened Flora

Common Name (<i>Scientific Name</i>)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
<i>Allocasuarina glareicola</i>	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil.	14 – OEH Atlas PMST	Low. Specific habitat is not present in the study area and the species was specifically targeted by surveys and not recorded.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
<i>Asterolasia elegans</i>	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also, likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Austral Toadflax (<i>Thesium australe</i>)	V	V	Austral Toadflax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Black Gum (<i>Eucalyptus aggregata</i>)	V	V	Black gum is endemic to south-eastern Australia and is found in the ACT, NSW and in a small isolated sub-population in Victoria. In the ACT the species occurs to a very minor extent, with only 16 known mature trees in the wild in 2014. In NSW, the species occurs predominantly in the South Eastern Highlands IBRA bioregion with the most eastern part of the distribution being located just within the Sydney Basin IBRA bioregion. All known Victorian stands are located within four kilometres of the town of Woodend, occurring primarily along roadsides and streamlines and are considered a sub-population given they are located several hundred kilometres from the closest stands in NSW. The species occurs mainly in the wetter, cooler and higher parts of the tablelands and is found at altitudes of 600–1200 m and generally in areas with annual rainfall of 600–900 (up to 1800) mm. It occurs on alluvial soils in, poorly drained flats and hollows adjacent to swamps, creeks and small rivers and up adjoining slopes (up to eight metres above waterline) onto Ordovician Sandstones and shales. It is usually found in open woodland with a grassy understory dominated by river tussock (<i>Poa labillardierei</i>) or kangaroo grass (<i>Themeda triandra</i>) and with few shrubs present. Black gum is often found with other eucalypts including snow gum (<i>Eucalyptus pauciflora</i>), manna or ribbon gum (<i>E. viminalis</i>), candlebark (<i>E. rubida</i>), black sallee (<i>E. stellutata</i>) and swamp gum (<i>E. ovata</i>).	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Brown Pomaderris	E	V	Within the Hawkesbury–Nepean region, <i>Pomaderris brunnea</i> is known from a small area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near	PMST	Low.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
<i>Pomaderris brunnea</i>			Camden. It is largely restricted to the Picton – Razorback Hills and Nattai Plateau. It is also found near Camden on the Cumberland Plain, Hawkesbury – Nepean Channels and Floodplains, and Hawkesbury – Nepean Terrace Gravels. This species shows a strong preference for alluvial soils and the shale/sandstone transitional zone of the residual Lucas Heights soil landscape around Bargo. Suitable habitat is the Sydney Hinterland Transitional Woodland around Bargo and the Alluvial Woodland and Riparian Forest along the Nepean River at Camden.		Not recorded in the locality and associated vegetation types are absent from the site.
7Bynoe's Wattle (<i>Acacia bynoeana</i>)	E	V	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils (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, 1999a).	12– OEH Atlas PMST	Low. Specific habitat is not present in the study area and the species was specifically targeted by surveys and not recorded.
<i>Darwinia biflora</i>	V	V	Occurs at 129 sites in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai Local Government Areas (LGAs). Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include <i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> and/or <i>E. squamosa</i> . The vegetation structure is usually woodland, open forest or scrub-heath.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Deane's Paperbark (<i>Melaleuca deanei</i>)	V	V	The distribution of the species extends from St. Albans (Hawkesbury LGA) in the north, Nowra (Shoalhaven LGA) in the south, and west to Falconbridge (Blue Mountains LGA). It mostly occupies broad flat ridgetops, dry ridges and slopes between 20 and 410 metres above sea level. It is strongly associated with sandy loam soils that are low in nutrients, sometimes with ironstone present. In southern Sydney, the species most frequently occurs on deep and well developed lateritic soils, i.e. soils where an indurated iron-rich layer usually overlies a mottled clay and a pallid clay. It occurs in a wide range of vegetation communities, but is most often found in Coastal Sandstone Ridgetop Woodland and to a lesser extent, Hinterland Sandstone Gully Forest, Sydney Hinterland Transition Woodland	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			and Coastal Sandstone Gully Forest and other communities on sandstone and transitional geology.		
<i>Dillwynia tenuifolia</i>	V	-	In western Sydney, <i>Dillwynia tenuifolia</i> is generally found on alluvial soils or on residual soil landscapes near the alluvial boundary. In this region this species is strongly associated with the alluvial Hawkesbury – Nepean Terrace Gravels (ferruginised clay and consolidated sand of the Londonderry Clay, the conglomerate of the Rickabys Creek Gravels, laterised sand and clay of the St Mary's Formation). <i>Dillwynia tenuifolia</i> also occurs to a lesser extent on the residual Cumberland Plain landscape on the Bringelly Shale and Ashfield Shale where there is influence from the quaternary alluvium of the Hawkesbury – Nepean Channels and Floodplains (e.g. South Creek, Kemps Creek, Ropes Creek, and Eastern Creek) and where the gravelly Berkshire Park soil landscape is present (i.e. Kemps Creek, Scheyville). This species is strongly associated with vegetation types including Castlereagh Scribbly Gum Woodland, Cooks River Castlereagh Ironbark Forest, and Shale/Gravel Transition Forest. Some outlier occurrences of <i>Dillwynia tenuifolia</i> occur in patches of Shale Plains Woodland or Alluvial Woodland where these communities intergrade with the aforementioned vegetation types.	486 – OEH atlas	Low. Not recorded during surveys for this proposal.
Downy Wattle (<i>Acacia pubescens</i>)	V	V	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravelly soils, often with ironstone.	6 – OEH Atlas PMST	Low. Not recorded during surveys for this proposal.
Eastern Australian Underground Orchid (<i>Rhizanthella slateri</i>)	V	E	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood, and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
<i>Eucalyptus sp. Cattai</i>	CE	-	Occurs in the area between Colo Heights and Castle Hill, north western Sydney, with historical records from central Sydney. Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small,	PMST	Low.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			clustered groups. The sites at which it occurs are generally flat and on ridge tops. Associated soils are laterised clays overlying sandstone. There are no known populations occur in conservation reserves.		Not recorded in the locality and associated vegetation types are absent from the site.
Hairy Geebung (<i>Persoonia hirsuta</i>)	E	E	<i>Persoonia hirsuta</i> is patchily distributed on the Central Coast and Tablelands of NSW, in an area bounded by Putty, Glen Davis and Gosford in the north, and Royal National Park (NP) and Hill Top in the south. It occurs in the Sydney coastal area (Gosford, Berowra, Manly and Royal NP), the Blue Mountains area (Springwood, Lithgow and Putty) and the Southern Highlands (Balmoral, Buxton, Yanderra and Hill Top). It is frequently found on ridge tops and the mid slopes of hills and rises in dry sclerophyll forest and woodland with a shrubby understorey, heath, shrubby thickets and sandstone scrubs from near sea level to 600 m altitude. Associated canopy species include <i>Eucalyptus sclerophylla</i> , <i>Corymbia gummifera</i> , <i>Leptospermum trinervium</i> , <i>Eucalyptus sieberi</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus sparsifolia</i> , <i>Corymbia eximia</i> and <i>Banksia ericifolia</i> . It grows on sandy to stony soils derived from sandstone or very rarely on shale and is often found in disturbed areas, like along track edges.	7 – OEH atlas PMST	Low. Specific habitat is not present in the study area and the species was specifically targeted by surveys and not recorded.
<i>Hibbertia puberula</i>	E	-	Recent work on this species and its relatives has 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. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath.	3 – OEH Atlas	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Illawarra Greenhood (<i>Pterostylis gibbosa</i>)	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum <i>Eucalyptus tereticornis</i> , Woollybutt <i>E. longifolia</i> and White Feather Honey-myrtle <i>Melaleuca decora</i> .	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Juniper-leaved Grevillea (<i>Grevillea juniperina</i> subsp. <i>juniperina</i>)	V	-	In the locality, <i>Grevillea juniperina</i> subsp. <i>juniperina</i> is highly associated with the Quaternary alluvium of South Creek and the Londonderry Clay and areas of adjacent Bringelly Shale.	1047 – OEH Atlas	Recorded

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Leafless Tongue-orchid (<i>Cryptostylis hunteriana</i>)	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Munmorah State Conservation Area, Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park and Ben Boyd National Park. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Magenta Lilly Pilly (<i>Syzygium paniculatum</i>)	E	V	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden, 2002). 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.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E	-	Endangered population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas. Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Grows in vine thickets and open shale woodland.	2 – OEH Atlas	Low. Specific habitat is not present in the study area and the species was specifically targeted by surveys and not recorded.
<i>Micromyrtus minutiflora</i>	E	V	The occurrences of <i>Micromyrtus minutiflora</i> to the north west of the study area (Londonderry, Llandilo, Agnes Banks, Berkshire Park) are strongly associated with the Hawkesbury – Nepean Terrace Gravels and the presence of the Londonderry Clay geological formation (clay with sand – top layer hard, semi-indurated zone of cemented ironstone pisolites) with the Berkshire Park and Agnes Banks soil landscapes (laterite and sand).	19 – OEH Atlas PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Nodding Geebung (<i>Persoonia nutans</i>)	E	E	<i>Persoonia nutans</i> is restricted to the Cumberland Plain. It is known from an area between Richmond and Macquarie Fields, particularly near the Nepean and Georges Rivers. The range of the species is fragmented, with about 99 per cent of the known populations occurring in the north of the distribution at Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs. This species is also known from Kemps Creek on the sandy lateritic soils. <i>Persoonia nutans</i> is strongly associated with the Hawkesbury – Nepean Terrace Gravels and the presence of the Londonderry Clay geological formation (clay with sand – top layer hard, semi-indurated zone of cemented ironstone pisolites) with the Berkshire Park and Agnes Banks soil landscapes (laterite and sand).	197 – OEH atlas PMST	Low. Species was specifically targeted by surveys and not recorded.
<i>Olearia cordata</i>	V	V	It generally restricted to the south-western hunter Plateau, eastern Colo Plateau and the far north Hornsby Plateau of which most of the population occurs within conservation reserves. Populations are small and scattered growing in dry open forest and open shrubland, including on sandstone ridges.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
<i>Pimelea curviflora</i> subsp. <i>curviflora</i>	V	V	<i>Pimelea curviflora</i> subsp. <i>curviflora</i> occurs on shaley / lateritic soils over sandstone and shale / sandstone transition soils.	15 – OEH Atlas PMST	Low. Specific habitat is not present in the study area and the species was specifically targeted by surveys and not recorded.
Spiked Rice-flower (<i>Pimelea spicata</i>)	E	E	The Spiked Rice-flower occurs in two disjunct areas: the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). Found on well-structured clay soils.	2 – OEH Atlas PMST	Low. The species was specifically targeted by surveys and not recorded.
Sydney Bush Pea (<i>Pultenaea parviflora</i>)	E	V	<i>Pultenaea parviflora</i> is confined to the Cumberland Plain and is mainly found between Penrith and Windsor. <i>Pultenaea parviflora</i> is generally found in scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on Wianamatta	481 – OEH Atlas	Low. Species was specifically targeted by surveys and not recorded.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			shale, tertiary alluvium or laterised clays, and in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	PMST	
Sydney Plains Greenhood (<i>Pterostylis saxicola</i>)	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Only one population occurs within a conservation reserve (Georges River National Park). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Tall Knotweed (<i>Persicaria elatior</i>)	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
White-flowered Wax Plant (<i>Cynanchum elegans</i>)	E	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes (Harden, 1992). This species typically occurs at the ecotone between dry subtropical forest/woodland communities.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Wingless Raspwort (<i>Haloragis exalata</i> subsp. <i>exalata</i>)	V	V	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. Flowering specimens in NSW are recorded from November to January.	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.
Yellow Gnat-orchid (<i>Genoplesium baueri</i>)	E	E	The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be	PMST	Low. Not recorded in the locality and associated vegetation types are absent from the site.

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			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. Grows in dry sclerophyll forest and moss gardens over sandstone.		

Habitat assessment table – Threatened Fauna

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Frogs					
Giant Burrowing Frog (<i>Heleoporus australiacus</i>)	V	V	In the northern population there is a marked preference for sandstone ridgetop habitat and broader upland valleys. In these locations, the frog is associated with small headwater creek lines and along slow flowing to intermittent creek lines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from the collected water. They have also been observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised over time and are still surrounded by another undisturbed habitat. Do not appear to inhabit areas that have been cleared for agriculture or for urban development. Breed in summer and autumn in burrows in the banks of small creeks (Cogger, 2000, NSW National Parks and Wildlife Service, 2001a).	PMST	Low Not recorded in the locality, and the habitats in the study area are not considered suitable for this species.
Green and Golden Bell Frog	E	V	Various types of habitat have been documented. For breeding utilises a wide range of waterbodies, including both natural and man-made structures, such	1 - OEH Atlas	Low

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
<i>(Litoria aurea)</i>			as marshes, dams and stream sides, and ephemeral locations that are more often dry than wet. Is found in various small pockets of habitat in otherwise developed areas and has the tendency of often turning up in highly disturbed sites. Lotic situations such as fast flowing streams appear to be one of the few water bodies not utilised, at least for breeding purposes (Department of Environment and Conservation, 2004, Department of Environment and Conservation, 2005).	PMST	The habitats in the study area are not considered suitable for this species and the Golden Bell Frog has not been recorded from the locality since 1999 when it was found at Merrylands. Records have not been made at other former habitats in the locality since the 1970s.
Growling Grass Frog (<i>Litoria raniformis</i>)	E	V	The species is currently widespread throughout the Murray River valley and has been recorded from six Catchment Management Areas in NSW: Lower Murray Darling, Murrumbidgee, Murray, Lachlan, Central West and South East. Found mostly amongst emergent vegetation, including <i>Typha</i> sp. (bullrush), <i>Phragmites</i> sp. (reeds) and <i>Eleocharis</i> sp.(sedges), in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams.	PMST	Low Not recorded in the locality, and the habitats in the study area are not considered suitable for this species.
Birds					
Australasian Bittern (<i>Botaurus poeciloptilus</i>)	V	E	Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spike rushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in territory that is more open. (Garnett and Crowley, 2000, NSW National Parks and Wildlife Service, 2002b).	PMST	Low. Not recorded in the locality, and the habitats in the study area are not considered suitable for this species.
Australian Painted snipe (<i>Rostratula australis</i>)	E	E	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,	5 - OEH PMST	Low. The habitats in the study area are not considered suitable for this species.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			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.		
Black Falcon (<i>Falco subniger</i>)	V	-	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 refer 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.	2 – OEH Atlas	Low. May occur as a vagrant to the study area.
Black-chinned Honeyeater (eastern subsp.) (<i>Melithreptus gularis gularis</i>)	V	-	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. 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.	3 - OEH Atlas	Low. There is a low possibility that this species may visit the study area as a vagrant.
Black-faced Monarch	-	M	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest,	PMST	Low.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
(<i>Monarcha melanopsis</i>)			tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.		There is a low possibility that this species may visit the study area as a vagrant.
Cattle Egret (<i>Ardea ibis</i>)	-	M	Subspecies <i>A. i. coromanda</i> is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan, 2005).	42 - OEH Atlas	Low. There is a low possibility that this species may visit the study area as a vagrant.
Dusky Woodswallow (<i>Artamus cyanopterus</i>)	V	-	The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests (Higgins and Peter, 2002).	40 – OEH Atlas	Moderate. Likely to fly over the study area.
Eastern Osprey (<i>Pandion haliaetus</i>)	V	M	Generally, a coastal species, occurring in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers to far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish (Pizzey and Knight, 1997).	PMST	Low The habitats in the study area are not considered suitable for this species.
Flame Robin (<i>Petroica phoenicea</i>)	V	-	In NSW the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats (Higgins and Peter, 2002). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	1 - OEH Atlas	Low. The habitats in the study area are not considered suitable for this species.
Fork-tailed Swift (<i>Apus pacificus</i>)	-	M	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	1 – OEH Atlas PMST	Moderate. Likely to fly over the study area.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Little Eagle (<i>Hieraaetus morphnoides</i>)	V	-	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet (Marchant and Higgins, 1993).	7 - OEH Atlas	Low. There is a low possibility that this species may visit the study area as a vagrant, but no high-quality habitat is present.
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	The distribution of the Little Lorikeet extends from just north of Cairns, around the east coast of Australia, to Adelaide. In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (Royal Australian Ornithologists Union, 2003). Little Lorikeets are generally considered to be nomadic (Higgins, 1999) and forage mainly on flowers, nectar and fruit. The breeding biology of Little Lorikeets is little known however studies indicate that nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts, and hollow openings are approximately 3 cm in diameter (Courtney and Debus, 2006).	2 – OEH Atlas	Moderate. Marginal habitat associated within the study area. May occasionally utilise habitat for foraging.
Oriental Cuckoo (<i>Cuculus optatus</i>)	-	M	Migrates from Eurasia as far south as Indonesia, New Guinea and North Australia. Some remain through Australia in the winter. Inhabits rainforest margins, monsoon forest, vine scrub and mangroves.	PMST	Low. Not recorded in the locality, and the habitats in the study area are not considered suitable for this species.
Painted Honeyeater (<i>Grantiella picta</i>)	V	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus <i>Amyema</i> , though it will take some nectar and insects. Its breeding	PMST	Low.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett and Crowley, 2000).		There is a low possibility that this species may visit the study area as a vagrant and it is unlikely to breed in the locality. Has not been previously recorded in the locality.
Powerful Owl (<i>Ninox strenua</i>)	V	-	A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, casuarina or Callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally, feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett and Crowley, 2000).	2 - OEH Atlas	Low. The habitats in the study area are not considered suitable for this species.
Rainbow Bee-eater (<i>Merops ornatus</i>)	-	M	Distributed across much of mainland Australia and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation	1 – OEH Atlas PMST	Low. There is a low possibility that this species may visit the study area as a vagrant.
Regent Honeyeater (<i>Anthochaera phrygia</i>)	CE	CE	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with <i>Casuarina cunninghamiana</i> and <i>Amyema cambagei</i> are important for feeding and breeding. Important food trees include <i>Eucalyptus sideroxylon</i> (Mugga Ironbark), <i>E. albens</i> (White Box), <i>E. melliodora</i> (Yellow Box) and <i>E. leucoxyton</i> (Yellow Gum) (Garnett and Crowley, 2000) with <i>Eucalyptus robusta</i> (Swamp Mahogany) and <i>Corymbia maculata</i> (Spotted Gum) used in coastal habitats.	3 - OEH Atlas PMST	Low. The Regent Honeyeater is a rare visitor to the locality and has not been recorded since 1998 when it was found adjacent Castlereagh Nature Reserve. This species is a sporadic visitor to the area and would focus habitat use on larger areas of flowering eucalypts in winter.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Rufous Fantail (<i>Rhipidura rufifrons</i>)	-	M	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies usually with a dense shrubby understorey often including ferns.	PMST	Low. There is a low possibility that this species may visit the study area as a vagrant.
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	-	M	Widespread in eastern Australia and vagrant to New Zealand. 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.	PMST	Low. There is a low possibility that this species may visit the study area as a vagrant.
Scarlet Robin (<i>Petroica boodang</i>)	V	-	In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. It prefers an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter, it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (Higgins and Peter, 2002).	3 – OEH Atlas	Low. The habitats in the study area are not considered suitable for this species.
Spectacled Monarch (<i>Monarcha trivirgatus</i>)	-	M	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges	PMST	Low. There is a low possibility that this species may visit the study area as a vagrant.
Spotted Harrier (<i>Circus assimilis</i>)	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is	1 - OEH Atlas	Low. There is a low possibility that this species may visit the study area as a migrant. The habitats in the study area are not considered suitable for this species.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.		
Square-tailed Kite (<i>Lophoictinia isura</i>)	V	-	This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes (Garnett and Crowley, 2000).	3 - OEH Atlas	Low. There is a low possibility that this species may visit the study area as a vagrant, but no high-quality habitat is present.
Swift Parrot (<i>Lathamus discolor</i>)	CE	E	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands (Garnett and Crowley, 2000),(Swift Parrot Recovery Team, 2001).	3 - OEH Atlas PMST	Moderate. Marginal habitat associated with the PCTs present in the study area. A record of this species was made near to the study area at Marsden Park in 2006 suggesting that this species occasionally utilises the habitats= in the locality. As such, the Swift Parrot is considered moderately likely to occur within the study area on an infrequent basis.
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	V	-	The Varied Sittella inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright	42 - OEH Atlas	Low. The habitats in the study area are not considered suitable for this species.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.		
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	V	M	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the seashore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea).	3 - OEH Atlas PMST	Low. There is a low possibility that this species may visit the study area as a vagrant, but no high-quality habitat is present.
White-throated Needletail (<i>Hirundapus caudacutus</i>)	-	M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey and Knight, 1997).	3 - OEH Atlas PMST	Moderate. A migrant that does not breed in the locality. Only likely to forage in the aerial spaces above the site.
Yellow Wagtail (<i>Motacilla flava</i>)	-	M	Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	PMST	Low. There is a low possibility that this species may visit the study area as a vagrant.
Mammals					
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	E	V	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However, the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments,	PMST	Low. No suitable habitat for this species is present in the study area.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.		
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	-	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill, 2008)	2 – OEH Atlas	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. tree hollows)
Eastern Free-tail bat (<i>Micronomus norfolkensis</i>)	V	-	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures (Churchill, 2008).	10 - OEH Atlas	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. tree hollows)
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks, but it may also forage in rainforest. Typically, it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill, 2008)	8 - OEH Atlas	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. tree hollows)
Greater Glider (<i>Petauroides volans</i>)	-	V	The Greater Glider inhabits eucalyptus forests and woodlands as this species feeds exclusively on Eucalyptus buds and leaves. They occupy tree hollows in the day and tree canopies at night (Department of Environment and Climate Change 2007).	PMST	Low. No suitable habitat for this species is present in the study area.
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lilly pillys. It roosts in the branches of	30 – OEH Atlas PMST	Moderate. This species is likely to forage in the study area on occasion.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			large trees in forests or mangroves (NSW National Parks and Wildlife Service, 2001b, Churchill, 2008)		
Koala (<i>Phascolarctos cinereus</i>)	V	V	Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum <i>Eucalyptus tereticornis</i> , Grey Gum <i>E. punctata</i> , Monkey Gum <i>E. cypellocarpa</i> and Ribbon Gum <i>E. viminalis</i> . In coastal areas, Tallowwood <i>E. microcorys</i> and Swamp Mahogany <i>E. robusta</i> are important food species (NSW National Parks and Wildlife Service, 1999b, NSW National Parks and Wildlife Service, 2003).	5 - OEH Atlas PMST	Low. Associated habitat types present on site however patches of habitat are small and isolated from larger areas of potential habitat. The last record from the locality was made in 2018 near the Air Services Transmission Station, Marsden Park.
Large Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	V	-	Usually found in well-timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill, 2008)	6 - OEH Atlas	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. cave roosts)
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	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. Found in well-timbered areas containing gullies.	PMST	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. cave roosts)

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Little Bent-wing Bat (<i>Miniopterus australis</i>)	V	-	Feeds on small insects beneath the canopy of well-timbered habitats including rainforest, Melaleuca swamps and dry sclerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred (Strahan, 1995).	1 - OEH Atlas	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. cave roosts)
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	-	V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, NSW and Queensland. The species is now largely restricted to the coast of central and northern NSW, with one inland occurrence near Parkes. In NSW, the New Holland Mouse is known from: Royal National Park (NP) and the Kangaroo Valley; Ku-ring-gai Chase NP; and Port Stephens to Evans Head near the Queensland border. Across the species' range, the New Holland Mouse is known to inhabit open heathland, open woodland with heathy understorey, and vegetated sand dunes.	PMST	Low. Not known from the locality.
<i>Petaurus australis</i> (Yellow-bellied glider)	V	-	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur 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. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	1 - OEH Atlas	Low. No suitable habitat for this species is present in the study area.

Common Name <i>(Scientific Name)</i>	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
Southern Myotis <i>(Myotis macropus)</i>	V	-	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. In NSW females have one young each year usually in November or December.	5 - OEH Atlas	Moderate. The study area is suitable for foraging, although no roosting habitat present (i.e. cave roosts)
Spotted-tailed Quoll <i>(Dasyurus maculatus)</i>	V	E	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service, 1999d). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service, 1999c, NSW National Parks and Wildlife Service, 1999d).	1 - OEH Atlas PMST	Low. The record of the Spotted-tailed Quoll in the locality is from Featherdale Wildlife Park. This species is considered unlikely to venture into the study given the lack of habitat and its fragmentation.
Fish					
Macquarie Perch <i>(Macquaria australasica)</i>	E	E	The Macquarie Perch is a riverine species that prefers clear water and deep, rocky holes with abundant cover such as aquatic vegetation, large boulders, debris and overhanging banks. In Victorian parts of the Murray-Darling, only small natural populations remain in the upper reaches of the Mitta Mitta, Ovens, Broken, Campaspe and Goulburn Rivers; translocated populations occur in the Yarra River and Lake Eildon. In NSW, natural inland populations are isolated to the upper reaches of the Lachlan and Murrumbidgee Rivers. Populations of the eastern form are confined to the Hawkesbury-Nepean	PMST Department of Primary Industries Freshwater threatened species distribution maps	None. The stream is not suitable as habitat as it lacks areas of clear water with deep, rocky holes and abundant cover. The study area is also east of the species' known distribution.

Common Name <i>(Scientific Name)</i>	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			and Shoalhaven river systems. Translocated populations in NSW are found in the Mongarlowe River, Queanbeyan River upstream of the Googong Reservoir and in Cataract Dam. In the ACT, it is restricted to the Murrumbidgee, Paddys and Cotter Rivers		
Australian Grayling <i>(Prototroctes maraena)</i>	E	V	The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones. The species has also recorded in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea. It has been recorded from many rivers across its range, particularly in Tasmania and Victoria. In NSW it is found from the Shoalhaven River south, with important river systems for the species including the Shoalhaven River, Bega River and Clyde River systems.	PMST Department of Primary Industries Freshwater threatened species distribution maps	None. The stream is not suitable as habitat as it lacks areas of cool, clear, freshwater with gravel substrate and areas alternating between pools and riffle zones. The study area is also north of the species' known distribution.
Invertebrates					
Cumberland Plain Land Snail <i>(Meridolum corneovirens)</i>	E	-	Primarily inhabits Cumberland Plain Woodland (an endangered ecological community). This community is grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	93 – OEH Atlas	Recorded
Dural Land Snail <i>(Pommerhelix duralensis)</i>	E	E	The Dural land snail is endemic to New South Wales. The species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringe of the Cumberland Plain on shale-sandstone transitional landscapes. The species has been observed resting in exposed areas, such as	PMST	Low.

Common Name (Scientific Name)	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
			on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.		This species is restricted to the edges of the Cumberland Plain so the habitat in the study area is not suitable.
Golden Sun Moth (<i>Synemon plana</i>)	E	CE	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. Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses <i>Austrostipa</i> spp. or Kangaroo Grass <i>Themeda australis</i> .	PMST	Low. No records in locality. Specific habitat is not present in the study area.

Note: This habitat assessment table does not consider habitat for species such as the Eastern Bristlebird, migratory wading birds, marine birds (such as albatross, petrels, terns, shearwater, noddy, frigatebird etc.), marine fish, whales, dolphins, sharks, rays, or turtles as the proposal will not impact on habitat for these species.

* Distribution and habitat requirement information adapted from Australian Government Department of the Environment <http://www.environment.gov.au/biodiversity/threatened/index.html> and NSW DPIE <http://www.environment.nsw.gov.au/threatenedspecies/>

+ Data source includes number of records from the NSW DPIE BioNet Atlas (Accessed May 2020); and Identified from the Protected Matters Search Tool (PMST) <http://www.environment.gov.au/epbc/pmst/index.html>

Key
CE = Critically endangered species
E = endangered species

Common Name <i>(Scientific Name)</i>	NSW status (BC Act or FM Act)	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence
<p><u>E2 = endangered population</u> <u>V = vulnerable species</u> <u>M = migratory species</u></p>					

Appendix C – Assessment of significance

Assessment of significance have been conducted for threatened species, populations and communities that were recorded in the study area during field surveys or were identified as having a moderate or higher potential to occur in the study area based on the presence of habitat (see Appendix B).

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

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.

Growth Centres SEPP

On 15 June 2010, the Threatened Species Conservation Amendment (Biodiversity Certification) Act 2010 (Biodiversity Certification Act) amended Part 7AA of the TSC Act and noted section 111 of the EP&A Act with the following regarding assessment impacts for activities undertaken within Biodiversity *certified* land:

- § An activity to which part 5 of the EP&A Act applies which is carried out or proposed to be carried out on Biodiversity certified land is taken, for the purposes of part 5 of the EP&A Act, to be an activity that is not likely to significantly affect any threatened species, population or ecological community, or its habitat under this Act. This means that:
- A determining authority under part 5 of the EP&A Act is not required under that part to consider the effect on biodiversity values of an activity carried out on biodiversity certified land and would not undertake an assessment of significance (despite section 111 of the EP&A Act).
 - The land that is subject to Biodiversity Certification is described in schedule 7, part 7 Bio Certification of Growth Centres SEPP and related environmental planning instruments (EPs) in the TSC Act.

The following assessment of significance are only required to assess the impacts on species and communities located in non-certified lands. The ecological communities and species subject to this assessment are outlined in Table B.1 along with the predicted impact from the proposal.

Table B.1 Threatened biodiversity subject to this assessment

Species / community	BC Act	EPBC Act	Predicted impact on habitat in non-certified lands (hectares)
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	E	-	1.38
Dusky Woodswallow (<i>Artamus cyanopterus cyanopterus</i>)	V	-	1.38
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	1.38
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	1.38
Juniper-leaved Grevillea (<i>Grevillea juniperina</i> subsp. <i>Juniperina</i>)	V	-	20 individuals
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	0.14
Swift Parrot (<i>Lathamus discolor</i>)	E	CE	0.14

Biodiversity Conservation Act 2016 assessment

Juniper-leaf Grevillea (*Grevillea juniperina* subsp. *juniperina*)

Grevillea juniperina subsp. *juniperina* grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. It's been recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest.

In the study area, 20 individuals of this species were counted in the non-certified land in the study area in disturbed vegetation in the road reserve north of Richmond Rd.

While on certified land in the study area, a larger portion of the population was identified in the roadside fragment of Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849) adjacent property DP715318 north of Richmond Rd. The certified area north of Richmond Rd is estimated at >500 individuals. This population is continuous with individuals on property DP715318 outside the road reserve, which is estimated at an additional >50 individuals.

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

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

The local population of Juniper-leaf Grevillea (*Grevillea juniperina* subsp. *juniperina*), are persisting in the roadside environment and adjacent lands and is considered a viable local population.

However, due to the removal of only highly disturbed habitat within the study area and the extent of the population that will remain on DP715318 adjacent the study area after construction, the local population is considered unlikely to be placed at further risk of extinction and the population (if present) would remain viable. The removal of plants within non-certified lands represents about 3per cent of the local population.

Where possible removal of this species will be avoided during construction through the implementation of exclusion zones, there is scope for this to occur.

If these 20 plants were to be removed, it is unlikely that the removal would result in an adverse effect on the life cycle of the threatened species such that a viable local population of the species is likely to be placed at risk of extinction considering the small number of plants to be affected and the abundance of these species remaining in the study area and locality.

- b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
 - i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
 - ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable.

- c) in relation to the habitat of a threatened species or ecological community:
 - i) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
 - ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*

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

The potential habitat of the threatened plant species within the study area includes a small slither of remnant along the property boundary of DP715318.

The predicted impact to these species is small when compared to the availability of suitable habitats in the study area and the extent to remain after construction and outside of the area to be disturbed.

Importantly, the proposal will not result in the breaking apart of large blocks of high-quality habitat for these species. No further habitat fragmentation on a landscape scale will occur as a result of the proposal. Isolation of habitats is also unlikely to increase substantially as existing habitat fragments will not be totally removed from the landscape. Critical ecosystem processes such as pollination and seed dispersal will still function as per the current state after the proposal has been completed.

The large of potential habitat for these species in the study area will be retained following the proposal.

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

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

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

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 39 listed KTPs (Table C.2). There are eight KTPs relevant to the Juniper-leaf Grevillea (*Grevillea juniperina* subsp. *juniperina*) that will be increased by the proposal. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation.

Conclusion

Grevillea juniperina subsp. *juniperina* may suffer a small reduction in extent of suitable habitat from the proposal. No further habitat fragmentation or isolation on a landscape scale will occur. The local populations of these species are likely to persist after the proposal is built, considering the absence of impacts or small proportion of the population being impacted. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to this threatened plant species.

Cumberland Plain Land Snail (*Meridolum corneovirens*)

Two individuals of the Cumberland Plain Land Snail were found on certified land in the study area during the surveys undertaken for the proposal. Non were found on non-certified land. The survey involved looking for active specimens on tree trunks, turning over suitable ground shelter including fallen timber, sheets of iron and exposed rocks and rubble, raking back bark, litter and debris from the ground, and searching in dense grass clumps. It is likely that the habitat on non-certified land, in the study area, is at least moderately suitable but no snails (live or dead) were found at the time of survey.

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

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

The Cumberland Plain Land Snail primarily inhabits Cumberland Plain Woodland. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps and occasionally shelters under rubbish where it is available. It feeds on fungus.

No snails were found on non-certified land in the study area during the survey undertaken for the proposal. However, the proposal would remove around 1.38 hectares of marginal habitat for the Cumberland Plain Land Snail. This small amount of habitat removal is not considered likely to have an adverse effect on the life cycle of the species such that a viable local population 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,*

Not applicable.

- c) in relation to the habitat of a threatened species or ecological community:
- iii) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
 - iv) *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*
 - v) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The proposal would remove around 1.38 hectares of marginal habitat for the Cumberland Plain Land Snail.

Fragmentation is unlikely to occur from the proposal as the work would largely involve removing vegetation from patch edges rather than breaking apart of large blocks of vegetation into many smaller patches. Importantly, the proposal would not result in the breaking apart of large blocks of high-quality habitats. No further habitat fragmentation on a landscape scale would occur because of the proposal. Isolation of habitats is likely to increase by a small extent as the distance between patches on either side of road would be increased.

Importantly, the proposal would not affect any high-quality patches of habitat for the Cumberland Plain Land Snail.

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

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

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

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 39 listed KTPs (Table C.2). There are eight KTPs relevant to the Cumberland Plain Land Snail (*Meridolum corneovirens*) that will be increased by the proposal. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs except for the clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

The Cumberland Plain Land Snail is known to inhabit vegetation adjacent Richmond Rd. However, the habitat, on non-certified land, in the development footprint is of lower quality as it is dominated by weeds and possesses little native ground cover or fallen woody debris. Overall, the project is unlikely to reduce the population size of the Cumberland Plain Land Snail or decrease the reproductive success of this species as the high-quality habitat would not be affected. After consideration of the factors above, an overall conclusion has been made that the project is unlikely to result in a significant effect to the Cumberland Plain Land Snail.

Threatened bird species

- § Dusky Wood swallow (*Artamus cyanopterus cyanopterus*)
- § Little Lorikeet (*Glossopsitta pusilla*)
- § Swift Parrot (*Lathamus discolor*)

The Swift Parrot has been recorded in the locality and sporadically occurs in the urbanised areas of western Sydney during winter. This species may pass through the study area during movements between larger foraging habitats (e.g. from vegetation patches to the east of Richmond Rd to Castlereagh Nature Reserve) where it may rest and forage in street trees or small vegetation remnants. Although no significant areas of foraging habitat are present, the Swift Parrot is considered moderately likely to occur in the study area on occasion. Likewise, the Little Lorikeet is also likely to use the trees in the study area in a similar manner as foraging habitat.

The Dusky Wood swallow is likely to fly over the study area on occasion and may temporarily perch on trees. However, the study area is considered unlikely to form suitable breeding habitat for this species and habitat use would be intermittent and minimal.

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

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

The Dusky Wood swallow is widespread in eastern, southern and south western Australia. It inhabits 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.

The distribution of the Little Lorikeet extends from just north of Cairns, around the east coast of Australia, to Adelaide. In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (Royal Australian Ornithologists Union, 2003). Little Lorikeets are generally considered to be nomadic (Higgins, 1999) and forage mainly on flowers, nectar and fruit. The breeding biology of Little Lorikeets is little known however studies indicate that nest hollows are located at heights of between 2 metre and 15 metre, mostly in living, smooth-barked eucalypts, and hollow openings are approximately 3 centimetre in diameter (Courtney and Debus, 2006).

The Swift Parrot is endemic to south-eastern Australia and breeds only in Tasmania. It migrates to mainland Australia in autumn. As such, the proposal would not affect breeding habitat for this species. Additionally, the study area does not contain any important winter foraging grounds. No impacts to the life cycle of the Swift Parrot species are anticipated as a result of the proposal and the 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.

The removal of habitat would affect the lifecycle of these species if they are present. However, due to the abundance of aggressive birds such as Noisy Miners, and adjacent urbanisation, the quality of the habitat is not considered high. Any birds that may use the habitat in the study area would also likely use adjacent habitats that are of higher quality. After the proposal has been built there would be sufficient habitat left in the vicinity of study area for these species to complete their lifecycles. The proposal is not considered likely to have an adverse effect on the life cycle of these species such that a viable local population of these 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,*

Not applicable.

- c) in relation to the habitat of a threatened species or ecological community:
 - iii) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
 - iv) *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*
 - v) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The extent of foraging habitat removal for these species is estimated at 0.14 hectares of foraging habitat (mix of mature, native tree species). This is a small impact compared to the extent of habitat availability in the locality.

Fragmentation is unlikely to occur from the proposal as the work would largely involve removing vegetation from patch edges rather than breaking apart of large blocks of vegetation into many smaller patches. Importantly, the proposal would not result in the breaking apart of large blocks of high-quality habitats. No further habitat fragmentation on a landscape scale would occur because of the proposal. Isolation of habitats is likely to increase by a small extent as the distance between patches on either side of road would be increased.

The study area does not contain high quality habitats for these species. These species may utilise the habitat on occasion but would not use it preferentially. The larger adjacent habitats are considered more important for these species than the roadside vegetation in the study area. No breeding habitat is present in the study area so the importance of the habitat for these species is limited.

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

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

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

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 39 listed KTPs. Of the 39 listed KTPs under the BC Act, nine are applicable to this assessment (see Table C.2). However, hygiene and weed control measures would reduce or avoid the impact of most KTPs except for clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

These bird species would suffer a small reduction in extent of foraging habitat from the proposal. No breeding habitat would be affected. The proposal is unlikely to reduce the population size of these species or decrease the reproductive success of these species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to threatened birds.

Threatened insectivorous bats

The species subject to this assessment include:

- § Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- § Little Bent-wing Bat (*Miniopterus australis*)
- § Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- § Eastern Freetail-bat (*Mormopterus norfolkensis*)
- § Southern Myotis (*Myotis macropus*)
- § Large-eared Pied Bat (*Chalinolobus dwyeri*)
- § Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The study area provides some habitat for species of threatened insectivorous bat including the Little Bentwing-bat, Large Bentwing-bat, Eastern Freetail-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Large-eared Pied Bat and the Southern Myotis (all listed as vulnerable under the BC Act). These species have been recorded widely from the locality or have been modelled to occur within the locality and are likely to forage in the habitats in the study area. Tree hollows are limited but the habitat is likely to be suitable as foraging habitat.

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:

- f) 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 Little Bentwing-bat roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. They often share roosting sites with the Eastern Bentwing-bat, and, in winter, the two species may form mixed clusters. Maternity colonies form in spring and birthing occurs in early summer. Males and juveniles disperse in summer. The Eastern Bentwing-bat primarily roosts in caves, but will also use derelict mines, storm-water tunnels, buildings and other man-made structures. The Eastern Bentwing-bat forms populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300-kilometre range of maternity caves.

The Eastern False Pipistrelle and Greater Broad-nosed Bat generally roost in eucalypt hollows but have also been found under loose bark on trees or in buildings. The Eastern Freetail-bat roosts mainly in tree hollows but will also roost under bark or in man-made structures. The Large-eared Pied Bat roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.

The Southern Myotis generally roosts close to water in caves, mine shafts, hollow-bearing trees, storm-water channels, buildings, under bridges and in dense foliage. The Southern Myotis forages over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW, females have one young each year usually in November or December.

All vegetation within the study area is likely to provide foraging habitat for these bat species. No hollow-bearing trees would be affected by the proposal, so no breeding habitat is predicted to be affected.

Impacts are likely to be restricted to loss of foraging habitat of 1.38 hectares. The impacts of the proposal are not expected to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction. Considerable foraging habitat would remain in the locality.

- g) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
- i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
 - ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable.

- h) in relation to the habitat of a threatened species or ecological community:
- i) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
 - ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
 - iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The proposal would remove around 1.38 hectares of potential foraging habitat. This amount of habitat removal is small when the amount of available foraging habitat in the locality is considered. The habitat within the study area is not limiting for these species. No roosting or breeding habitat would be affected.

Importantly, the proposal would not result in fragmentation of habitat for these species. These species are highly mobile and will freely fly long distances over open areas to move between habitats. The proposal would not affect the movement of these bats between habitat patches.

The vegetation in the study area would form a small component of a larger foraging range for these species. Vegetation at the edge of vegetation patches is likely to be a focal point of foraging activity. The loss of native vegetation from the study area would reduce the amount of foraging habitat available for these species by a small amount. However, when compared to the larger and higher quality vegetation remnants in the locality, the vegetation within the study area is not considered as important for the long-term survival of these species.

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

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

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

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 39 listed KTPs. Of the 39 listed KTPs under the BC Act, nine are applicable to this assessment (see Table C.2). However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

These bat species would suffer a small reduction in extent of foraging habitat from the proposal. No roosting habitat would be affected. The proposal is unlikely to reduce the population size of these species or decrease the reproductive success of these species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to threatened insectivorous bats.

Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox is considered moderately likely to forage in the trees within the study area, particularly *Eucalyptus moluccana*. No roost camps are present in the study area but the bats from the Ropes Crossing, Emu Plains, Yarramundi and Penrith camps are likely to forage in the study area.

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

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

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometre of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Annual mating commences in January and conception occurs in April or May; a single young is born in October or November.

There are no roost camps located in the study area and at the time of this assessment the proposal would not directly impact on any known breeding / maternity site. As such, the impacts of the proposal to the Grey-headed Flying-fox would be limited to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase.

The proposal would remove around 0.14 hectares of foraging habitat (mix of mature, native tree species); however, removal of vegetation would be avoided where possible. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within the locality. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of the camps located near the study area, the proposal is not expected to significantly affect the life cycle of the species.

The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species.

- b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
 - i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
 - ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable.

- c) in relation to the habitat of a threatened species or ecological community:
 - i) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
 - ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
 - iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The potential habitat of the Grey-headed Flying-fox within the study area is limited to foraging habitat and includes fruiting and flowering trees present. The extent of potential foraging habitat for the Grey-headed Flying-fox would be reduced by around 0.14 hectares of foraging habitat (mix of mature, native tree species). This amount of habitat removal is small when the amount of available foraging habitat in the locality is considered.

Importantly, the proposal would not result in fragmentation of habitat for the Grey-headed Flying-fox. This species is highly mobile and will freely fly long distances (up to 50 kilometres) over open areas including urbanised city centres to move between roost camps and foraging sites. The proposal would not affect the movement of the Grey-headed Flying-fox between habitat patches.

Importantly, the proposal would not affect the most important habitats for Grey-headed Flying-fox within the locality. The most important habitats for the local Grey-headed Flying-fox sub-populations are the roosting camps at Ropes Crossing, Emu Plains, Yarramundi and Penrith. These camps would not be affected by the proposal. Foraging habitat within the study area is likely to form part of an overall foraging range of these sub-populations and would only form a small proportion of available habitat for this species. As such, the foraging habitat within the study area is unlikely to be of critical importance for the survival of the Grey-headed Flying-fox within the locality.

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

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

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

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 39 listed KTPs. Of the 39 listed KTPs under the BC Act, nine are applicable to this assessment (see Table C.2). However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

The Grey-headed Flying-fox would suffer a small reduction in extent of suitable foraging habitat from the proposal of around 0.14 hectares of foraging habitat (mix of mature, native tree species). No roosting camps or other important habitat would be impacted. As such, the proposal is considered unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to the Grey-headed Flying-fox.

Environment Protection and Biodiversity Conservation Act 1999 assessment

Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox is considered moderately likely to utilise the PCTs within the study area as foraging habitat.

The Grey-headed Flying-fox is not known but the species exists as one interconnected population along the eastern Australian coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. As a result, for this assessment, the impact has been considered in terms of 'important habitat' as opposed the presence of an 'important population'.

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

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

There are no roost camps in the study area and the action would not affect any known permanent roosting, breeding / maternity site. Therefore, it is likely that the impacts of construction and operation of the action would be confined to minor loss of foraging habitat caused by direct clearing or damage to native vegetation during the construction phase. There is also a low risk of vehicle strike during operation.

The proposal would remove around approximately 0.14 hectares of foraging habitat (mix of mature, native tree species). Given the relative widespread nature of similar native vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of local individuals, the proposal is not expected to significantly affect important habitat or lead to a long-term decrease in the size of an important population.

- 2) reduce the area of occupancy of an important population

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

- 3) fragment an existing important population into two or more populations

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

- 4) adversely affect habitat critical to the survival of a species

This species typically exhibits very large home range and Grey-headed Flying-fox is known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources. There are no known roost camps within the study area and the site does not provide critical roosting habitat. However, there are a number of known roost camps within a 50-kilometre radius of the proposal, the closest being the Ropes Crossing, Emu Plains, Yarramundi and Penrith camps. The draft recovery plan for the Grey-headed Flying-fox identifies critical foraging habitat for this species as:

- § Productive during winter and spring, when food bottlenecks have been identified
- § Known to support populations of >30,000 individuals, within an area of 50-kilometre radius of a camp site

- § Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)
- § Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- § Known to be continuously occupied as a camp site.

Native vegetation within the study area may constitute critical foraging habitat but the affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50-kilometre radius of the closest camps. Given the high-quality foraging habitats within the locality, outside of the study area, the proposal is not expected to adversely affect foraging habitat critical to the survival of this species in this region.

- 5) disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat during the breeding cycle of the species. The upgrade would not directly impact on a known roost camp / breeding or maternity site. Alternative foraging resources are available in the locality that would provide suitable resources during the maternity season. The habitats in the study area are not limiting for this species.

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

The impacts to foraging habitat are minimal and no evidence of a roost camp has been identified from the study area. This impact is not expected to lead to a decline in the species in the region given the availability of high-quality foraging habitat available to local animals in surrounding the study area.

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

The action is unlikely to result in an invasive species harmful to the Grey-headed Flying-fox becoming established in the habitat. The potential for weed invasion was considered possible with a proposal of this nature and appropriate controls are required during construction and operation of the road to reduce this threat. The management of invasive species would be managed under the construction environmental management plan and during operation of the road using best practice methods.

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

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

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the road. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as part of the CEMP to prevent the introduction or spread of pathogens.

The project mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease-causing agents such as bacteria and fungi

- 9) interfere substantially with the recovery of the species.

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

- § Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- § Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- § Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- § Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- § Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- § Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- § Monitor population trends for the Grey-headed Flying-fox
- § Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- § Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- § Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan

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

Conclusion

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

Swift Parrot (*Lathamus discolor*)

The Swift Parrot (*Lathamus discolor*) is considered likely to occur based on the presence of suitable winter foraging habitat.

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

The study area contains some potential foraging habitat for the Swift Parrot. While the habitat in the study area is not optimal, the loss of potential feed trees would directly affect the species opportunity to feed in the area. However, the study area is not considered a critical area for the Swift Parrot. The Swift Parrot may utilise trees in the study area for foraging intermittently when no other suitable inland (i.e. box ironbark woodlands) or coastal resources (i.e. Spotted Gum or Swamp Mahogany forests) are available. The potential foraging habitat for this species would be reduced by about 0.14 hectares of foraging habitat (mix of mature, native tree species). Within the Cumberland subregion, this potential habitat removal represents a small proportion of currently available habitat for this species.

The Swift Parrot does not breed in the study area and the extent of habitat remaining in the locality area would provide sufficient resources to sustain future visitation, such that the action itself is unlikely to lead to a long-term decrease in the size of the Australian population.

- 2) reduce the area of occupancy of the species

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

The project would contribute to the loss of potential foraging habitat which would reduce the area of habitat available. However, the action would not reduce the area of occupancy of this species which is estimated at 4,000 square kilometres.

- 3) fragment an existing population into two or more populations

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

- 4) adversely affect habitat critical to the survival of a species

Key habitats for this species on the coast and coastal plains of New South Wales include large stands of Spotted Gum (*Corymbia maculata*), Swamp Mahogany (*Eucalyptus robusta*), Red Bloodwood (*Corymbia gummifera*) and Forest Red Gum (*Eucalyptus tereticornis*) forests. The study area supports some Forest Red Gum, and therefore suitable habitat for this species is considered to be present.

The habitat within the study area is considered to be secondary habitat for the Swift Parrot as this species is not regularly recorded from the area and it is not known as critical habitat.

- 5) disrupt the breeding cycle of a population

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

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

Foraging habitat for this species would be reduced by about 0.14 hectares of foraging habitat (mix of mature, native tree species). As a large-scale migrant, it has the ability to cover vast areas of its winter range, seeking suitable flowering eucalypt habitat. The species is an occasional visitor to the region and may utilise trees in the study area for foraging intermittently when no other suitable resources are available. The action is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- 7) result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

The main invasive species harmful to the habitat for the swift parrot are weeds. The action may result in weed invasion the management of invasive species would be managed under the CEMP and during operation.

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

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback.

Machinery associated with vegetation clearance and subsequent construction has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the road. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as part of the CEMP to prevent the introduction or spread of pathogens.

The project mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease-causing agents such as bacteria and fungi.

9) interfere with the recovery of the species.

The *National Recovery Plan for the Swift Parrot* (Saunders and Tzaros, 2011) aims to prevent further population decline of the Swift Parrot and to achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity. These objectives would be achieved by implementing recovery actions for each of the following specific recovery objectives:

- § Objective 1: To identify and prioritise habitats and sites used by the species across its range, on all land tenures.
- § Objective 2: To implement management strategies to protect and improve habitats and sites on all land tenures
- § Objective 3: To monitor and manage the incidence of collisions, competition and Beak and Feather Disease (BFD).
- § Objective 4: To monitor population trends and distribution throughout the range.

These objectives, and the associated recovery actions outlined in the *National Recovery Plan for the Swift Parrot* (Saunders and Tzaros, 2011) are not applicable to the study area or proposal. The identified recovery actions mostly relate to identifying the extent and quality of habitat, monitoring, raising community awareness, and coordinating and reviewing the recovery process. There is an action relating to manage and protect Swift Parrot habitat at the landscape scale. However, this action applies to fencing off habitat on private land to encourage regeneration of habitat, revising forestry practices, developing a strategic management plan for Swift Parrot breeding habitat in Tasmania, and providing Swift Parrot conservation information for consideration during the New South Wales Local Government Local Environmental Planning review process. The recovery actions identified in the National Recovery Plan for the Swift Parrot (Saunders and Tzaros, 2011) would not be interfered with by the proposal.

Conclusion

The Swift Parrot would suffer a small reduction in extent of foraging habitat from the action. The action is unlikely to reduce the population size of the Swift Parrot or decrease the reproductive success of this species. The action would not interfere with the recovery of the Swift Parrot. For the Swift Parrot, impacts are most likely to be significant where a proposal or activity may result in loss of habitat in, or adjacent to priority foraging, nesting and roosting sites (Saunders and Tzaros, 2011). The proposal would not impact on any priority foraging habitat. As such, after consideration of the factors above, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Swift Parrot.