Transport for NSW

New Richmond Bridge and Traffic Improvements Stage 2

Biodiversity assessment report for review of environmental factors (REF)

September 2024

NSW GOVERNMENT

transport.nsw.gov.au

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Introduction

Transport for NSW (Transport) proposes to upgrade Bells Line of Road / Kurrajong Road between Crooked Lane, North Richmond and Old Kurrajong Road, Richmond and construct a new bypass south of Richmond town centre. This is known as New Richmond Bridge and traffic improvements – Stage 2 (the proposal). . The proposal is within the Hawkesbury Local Government Area (LGA). The proposal is being carried out as part of a wider program of traffic improvements between Richmond and North Richmond which is being delivered in two stages. Stage 1 involves upgrading The Driftway between Londonderry Road and Blacktown Road to improve safety and flood resilience and to cater for future traffic growth. Stage 1 has been separately determined by Transport and is, being delivered separately to the proposal. The proposal assessed in this BAR is Stage 2.

The proposal (Stage 2) will enhance the traffic and flood resilience of the road network, cater for increased traffic ahead of the Richmond area's anticipated growth and improve road safety and efficiency along the corridor for motorists, cyclists and pedestrians.

The study area, defined by a 20-metre buffer around the proposal area, is located within the Cumberland sub-region of the Sydney Basin Bioregion and within the Hawkesbury - Nepean Channels and Floodplains, and the Hawkesbury - Nepean Terrace Gravels Mitchell Landscapes, within which 79% and 69% of native vegetation has been previously cleared, respectively.

The study area is extensively cleared with small areas of remnant vegetation. Most tree and shrub vegetation is planted native and exotic vegetation. Connectivity is limited across the study area except for the northern portion of the proposal area which is linked to large areas of vegetation via Redbank Creek. This connectivity is partially fragmented by minor roads and residential development before reaching the greater Blue Mountains wilderness. Minor connectivity is also present along the northern bank of the Hawkesbury River, extending c. 2 kilometres upstream.

Native vegetation

The vegetation in the proposal area is comprised of six Vegetation Zones (as shown in Table 1), including three remnant Plant Community Types (PCTs), one planted native vegetation zone and two exotic vegetation zones. All vegetation is in low to low-moderate condition with high abundance of exotic species. Fifteen plots were conducted across these vegetation types, in excess of BAM requirements, so as to confirm condition consistency across vegetation zones.

Each of the remnant PCTs identified (Vegetation Zones 1–3) are consistent with a threatened ecological community (TEC) listed in NSW under the *Biodiversity Conservation Act 2016* (BC Act). The TECs include:

- Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (Critically Endangered)
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) (Endangered)
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)(Endangered)

Impacts to these TECs are shown in Table 1 below.

Table 1: summary of vegetation zones, PCTs and TECs within the proposal area

Veg. zone	Plant community type (PCT) / vegetation community	Broad condition class	TEC	Area to be impacted (ha)		
				Stage 2A	Stage 2B	Total
Zone 1	3320 Cumberland Shale Plains Woodland	Low-moderate	Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (Critically Endangered)	0.03	0.31	0.34
Zone 2	4025 Cumberland Red Gum Riverflat Forest	Low-moderate	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) (Endangered)	1.29	0.07	1.36

Veg. zone	Plant community type (PCT) / vegetation community	Broad condition class	TEC	Area to be impacted (ha)		
				Stage 2A	Stage 2B	Total
Zone 3	3975 Southern Lower Floodplain Freshwater Wetland	Low-moderate	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)(Endangered)	0.54	0.01	0.55
Zone 4	Planted native vegetation	Low	Not a TEC	1.63	2.24	3.87
			Native vegetation total	3.49	2.63	6.12
Zone 5	Exotic trees and shrubs	Low	Not a TEC	6.79	1.71	8.5
Zone 6	Exotic grassland / pasture	Low	Not a TEC	29.23	6.09	35.32
			Exotic vegetation total	36.02	7.8	43.82
			Grand total	39.51	10.43	49.94

Threatened species

No naturally occurring threatened flora species were observed within the proposal area. Cultivated individuals of *Macadamia integrifolia* (Macadamia Nut) were observed, but as these individuals are planted they are not of conservation importance.

Five threatened fauna species were recorded within the study area: Eastern Coastal Free-tailed Bat, Large Bent-winged Bat, Southern Myotis, Grey-headed Flying-fox and Greater Broad-nosed Bat. All these species are listed under the BC Act as Vulnerable, while Grey-headed Flying-fox is also listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as Vulnerable. Important Habitat for Swift Parrot (BC Act: Endangered; EPBC Act Critically Endangered) is mapped within the proposal area.

The habitats within the proposal area are highly modified and of low to moderate quality and do not possess important habitat features critical to the persistence of the threatened fauna species recorded or predicted from the locality.

No suitable habitat for threatened marine or aquatic species is present in the study area, but 0.03 ha of Key Fish Habitat will be directly impacted.

Impact assessment

The direct, indirect, and cumulative ecological impacts of the proposal have been carefully considered in Section 5 of this report. Recommendations have been outlined within Section 4 to avoid and minimise these impacts, while Section 6 details measures to mitigate residual impacts, to address threatening processes and to create a more positive ecological outcome for threatened biodiversity.

The Proposal will directly impact 6.12 hectares of native vegetation, 8.50 hectares of exotic trees and shrubs, and 35.32 hectares exotic pasture and lawn, which includes the following impacts (PCT below refers to Plant Community Type):

- PCT 3320 Cumberland Shale Plains Woodland equivalent to TEC Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (Critically Endangered): 0.34 hectares
- PCT 4025 Cumberland Red Gum Riverflat Forest equivalent to River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) (Endangered): 1.36 hectares
- PCT 3975 Southern Lower Floodplain Freshwater Wetland equivalent to Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)(Endangered): 0.55 hectares
- Planted native vegetation: 3.87 hectares

- Up to 0.11 hectares potential habitat for threatened flora within area excluded from survey
- Up to 14.62 hectares known or potential habitat for threatened fauna.

Significance assessments under Section 7.2 of the BC Act, Division 12 of the *Fisheries Management Act 1994* (FM Act) and the *EPBC Act Significant Impact Guidelines 1.1* concluded that the proposal will not cause a significant impact on any threatened species or community. No referral under the EPBC Act is required.

Impact avoidance and minimisation

The following strategies and actions have been undertaken to either avoid or minimise impacts on biodiversity values:

- Impacts from clearing native vegetation and threatened species habitat has been minimised by locating the proposal to utilise:
    - existing road corridors.
    - cleared areas.
    - low-condition, planted and exotic vegetation.
    - areas with no mapped Biodiversity Values.
- Minimisation of impacts to recorded TECs Cumberland Plain Woodland, River-flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains
- Avoidance of impacts to mapped Coastal Wetlands
- Locating ancillary facilities in areas where there are no or low biodiversity values (e.g. utilising Hanna Park for temporary access during construction).

Offsetting, and tree and hollow replacement

Offset thresholds relevant to the Transport Biodiversity Policy are met by the proposal for TECs, threatened fauna habitat and Key Fish Habitat in accordance with Transport No Net Loss guidelines (2023) and Part 6 of the Biodiversity Conservation Regulation (2017). Preliminary offset calculations are summarised as follows:

- 0.34 hectares impact on 3320 Cumberland Shale Plains Woodland equivalent to 9 ecosystem credits.
- 0.93 hectares impact on Swift Parrot mapped Important Habitat equivalent to 23 species credits
- 1.91 hectares impact on Southern Myotis habitat equivalent to 38 species credits
- 0.03 hectares of Key Fish Habitat offset through consultation with DPI

Preliminary estimates for tree and hollow replacement are as follows:

- 6195 native trees and 1564 exotic amenity trees equivalent to $888,750 payment into Transport conservation fund
- 31 artificial replacement hollows, equivalent to $5,200 payment into Transport conservation fund

1. Introduction

1.1 Proposal identification

Transport for NSW (Transport) proposes to upgrade Bells Line of Road / Kurrajong Road between Crooked Lane, North Richmond and Old Kurrajong Road, Richmond and construct a new bypass south of Richmond town centre. This is known as New Richmond Bridge and traffic improvements – Stage 2 (the proposal). The new route between Richmond and North Richmond would provide a minimum five per cent annual exceedance probability (AEP) flood resilience (equivalent to the 1 in 20 chance per year flood event). The proposal is about 50 kilometres north-west of the Sydney Central Business District (CBD) and about 33 kilometres north-west of Parramatta. It is in the Hawkesbury City Council local government area (LGA).

The proposal would be delivered in two stages, known as Stage 2A and Stage 2B. Should this REF be determined, and the already committed funding by the Australian Government and NSW Government released, Stage 2A would be constructed. This is expected to be complete by 2029. The timing of Stage 2B would be subject to available funding and Transport will continue to seek funding in upcoming State and Federal budgets to deliver the rest of the upgrades.

Stage 2A of the proposal includes a new four-lane bridge over the Hawkesbury River about 30 metres downstream of the existing Richmond Bridge, widening of Bells Line of Road through North Richmond to provide two lanes in each direction between the new bridge and the Terrace Road / Grose Vale Road intersection and a new bypass to the south of the Richmond town centre. The bypass would extend about 1.7 kilometres across the floodplain between the Kurrajong Road / Old Kurrajong Road intersection and Castlereagh Road / Inalls Lane / Southee Road intersection. Stage 2A of the proposal would also provide an active transport corridor between North Richmond and Richmond. This would include a new shared path on the southern side of Kurrajong Road between Old Kurrajong Road and Chapel Street and the conversion of the existing Richmond Bridge into an active transport connection across the Hawkesbury River.

Stage 2B of the proposal includes widening of Bells Line of Road between the Terrace Road / Grose Vale Road intersection and west of Charles Street and at its intersection with Crooked Lane. The bypass would also be extended 1.3 kilometres east from Castlereagh Road to Londonderry Road and would be a new road alignment to the south of Southee Road. Southee Road would connect to the bypass opposite Valder Place. The Londonderry Road / bypass / Vines Drive intersection would also be upgraded.

1.2 Proposal background

Richmond Bridge is currently operating at capacity during peak periods and future traffic demand in the area will increase, driven by residential development west of the Hawkesbury River and background traffic growth. This is expected to further increase congestion and travel times along this arterial corridor.

Richmond Bridge is closed in moderate flood events when flood levels reach about eight metres Australian Height Datum (AHD), which is at about the 50 percent AEP flood level. Since 2020, Richmond Bridge has closed multiple times due to flooding. The closure of this bridge results in disruption to travel between North Richmond and Richmond and disrupts regional traffic using the Bells Line of Road corridor.

The Australian Government and NSW Government are funding traffic improvements between North Richmond and Richmond including a new bridge over the Hawkesbury River. This initiative is part of a wider program of traffic improvements between North Richmond and Richmond which includes previous intersection improvements at three key intersections on the approach to the existing Richmond Bridge, including Bells Line of Road / Grose Vale Road intersection in North Richmond as well as Kurrajong Road / Old Kurrajong Road intersection and March Street / Bosworth Street intersection in Richmond. The proposal builds on the previous intersection improvements and is being carried out as part of a wider program of traffic improvements between Richmond and North Richmond which is being delivered in two stages (Stage 1 and Stage 2). They are:

- **Stage 1** involves upgrading The Driftway between Londonderry Road and Blacktown Road to improve safety and flood resilience. This project has been separately determined by Transport and is being delivered separately to the proposal.
- **Stage 2** is the proposal and it aims to improve traffic efficiency, flood resilience, active transport connections and safety of the road network between Richmond and North Richmond.

1.3 The proposal

The key features of Stage 2A of the proposal would include:

a new four-lane bridge over the Hawkesbury River (about 360 metres long) about 30 metres downstream of the existing bridge, with two eastbound and two westbound lanes and the road level at a height to provide a five per cent AEP flood immunity

- widening of Bells Line of Road and Kurrajong Road to two lanes in each direction from the Terrace Road / Grose Vale Road intersection in North Richmond to just east of the Kurrajong Road / Old Kurrajong Road intersection in Richmond
- a new two-lane bypass south of Richmond town centre (one lane in each direction) between the Kurrajong Road / Old Kurrajong Road intersection and just east of the Castlereagh Road / Inalls Lane / Southee Road intersection, including:
    - a three-way signalised intersection connecting Kurrajong Road and the new bypass, including closure of the existing northern and southern legs of Old Kurrajong Road at Kurrajong Road
    - a two-way gated emergency driveway access connecting the northern leg of Old Kurrajong Road and Kurrajong Road, to be opened during flood evacuation events
    - a 150-metre-long bridge over a tributary to Mareh-Mareh Lagoon (near Inalls Lane)
    - a 120-metre-long bridge over the floodplain parallel to Inalls Lane
    - a roundabout at the Castlereagh Road / Inalls Lane / bypass intersection, with a local road connection to Southee Road
    - local road connections to Yarramundi Lane and Victoria Place from the bypass
    - truncation of Inalls Lane near Mareh-Mareh Lagoon, with local road connections to Inalls Lane from the bypass via Yarramundi Lane and near Drift Road
    - closure of the existing Drift Road intersection with Inalls Lane, with a new local road connection to Drift Road from the bypass
    - footpaths along the southern side of the of the bypass between Drift Road and Castlereagh Road and on each side of the roundabout
- an upgraded active transport network between Richmond and North Richmond, including:
    - a new shared path along the southern side of Kurrajong Road between the existing Richmond Bridge and Chapel Street, Richmond, a distance of about two kilometres, connecting to existing paths along March Street, Richmond
    - conversion of the existing Richmond Bridge and approaches into an active transport only connection
    - active transport connections from the existing Richmond Bridge through Hanna Park to an upgraded shared path on the northern side of Bells Line of Road until east of the Bells Line of Road / Terrace Road / Grose Vale Road intersection
- retention of bus stops along Bells Line of Road and Kurrajong Road
- new drainage infrastructure, including swales and water quality basins
- utilities connections and upgrades (including electrical, gas, water and telecommunications)
- new intelligent transport systems including closed-circuit television (CCTV) cameras to monitor traffic flow and assist with emergency management
- new maintenance access to the three new bridge structures
- permanent retaining walls near the approach to the new four-lane bridge in North Richmond and along Kurrajong Road near the new shared path
- driveway adjustments and tie-ins, including along Bells Line of Road, Beaumont Avenue, Kurrajong Road, Old Kurrajong Road, Inalls Lane, Drift Road and Castlereagh Road
- eight new parking spaces on the northern side of Beaumont Avenue, near its intersection with Terrace Road to replace parking spaces removed on Bells Line of Road

- finishing works, including kerb and gutters, signs, landscaping, lighting and line marking
- construction activities, including:
  - early work, including the establishment of a new compliant handrail on the existing Richmond Bridge
  - geotechnical, contamination and utility investigations which may be carried out as early work
  - a temporary roundabout at the Kurrajong Road / Chapel Street intersection
  - civil earthworks, bridge structural works, retaining walls, drainage work, utilities relocations and tie-in work and adjustments to adjoining sections of road
  - establishment of temporary ancillary facilities to support construction, including compound sites, site offices, stockpile and laydown locations, temporary access tracks and water quality devices
  - demolition work for structures and property features that fall in the proposal area.

The key features of Stage 2B of the proposal would include:

- localised widening of Bells Line of Road to provide a dedicated right-turn lane into Crooked Lane
- widening of Bells Line of Road to two lanes in each direction from west of Charles Street to the Terrace Road / Grose Vale Road intersection in North Richmond
- additional capacity improvements to the Bells Line of Road / Terrace Road / Grose Vale Road intersection, including an additional eastbound through lane at the intersection
- an upgraded shared path on the northern side of Bells Line of Road from west of Charles Street to the Terrace Road / Grose Vale Road intersection in North Richmond
- extension of the bypass (one lane in each direction) between the Castlereagh Road roundabout and just south of the Londonderry Road / Southee Road intersection, including:
  - a new signalised intersection at the junction of Londonderry Road, the new bypass and Vines Drive
  - closure of the Southee Road local road connection from Castlereagh Road and closure of Southee Road at Londonderry Road
  - a new local road connection to Southee Road opposite Valder Place, with left and right turn lanes provided at this intersection.
  - two new bus stops along the bypass near Hill Avenue (one eastbound and one westbound), with a footpath connection to Southee Road
- retention of bus stops along Bells Line of Road and Londonderry Road
- new drainage infrastructure, including swales and a water quality basin on Londonderry Road
- noise screening mounds, walls and/or additional attenuation between the bypass and Southee Road along the extended section of the bypass between Castlereagh Road and Londonderry Road
- utilities connections and upgrades (including electrical, gas, water and telecommunications)
- new intelligent transport systems at the Londonderry Road / bypass / Vines Drive intersection including closed-circuit television (CCTV) cameras to monitor traffic flow and assist with emergency management
- driveway adjustments and tie-ins, including along Bells Line of Road, the bypass and Londonderry Road
- finishing works, including kerb and gutters, signs, landscaping, lighting and line marking
- construction activities, including:
  - geotechnical, contamination and utility investigations which may be carried out as early work
  - civil earthworks, retaining walls, drainage work, utilities relocations and tie-in work and adjustments to adjoining sections of road
  - establishment of temporary ancillary facilities to support construction, including compound sites, site offices, stockpile and laydown locations, temporary access tracks and water quality devices

- demolition work for structures and property features that fall in the proposal area.

An overview of the proposal is provided in Figure 1.2 a-b.

1.3.1 Assessment areas

The following terms are used in the BAR to define assessment areas and proposal boundaries:

- The proposal – the construction of a new bridge over the Hawkesbury River, a bypass of Richmond town centre, widening and upgrades to adjoining roads, and associated services. The proposal includes both Stages 2A and 2B (see detailed description above).
- The proposal area – the area to be directly impacted by the proposal. This comprises the construction footprint of the proposed bridge and roads, including all roadside cut and fill, construction compound areas and parking areas for vehicles (refer to Figure 1.2 a-b). It forms part of, but is not equivalent to, the study area or assessment area.
- Operational footprint – the area that will be subject to ongoing operational impacts from the proposal. This includes the bridge, road, drainage and all associated infrastructure for the ongoing operation of the proposal.
- Study area – is the portion of land that encompasses all surveys undertaken. The study area extends as far as is necessary to assess all important biodiversity values known and likely to occur within the proposal area and includes the proposal area and any additional areas which are likely to be affected by the proposal, either directly or indirectly. In this case, the study area is defined as the proposal area including a 20 metres buffer that captures the land surrounding the Proposal which may be affected by indirect impacts.
- Landscape assessment area – the proposal area and the area of land within a 500 metres buffer zone is identified as per Subsection 3.1.2 of the Biodiversity Assessment Method (BAM).

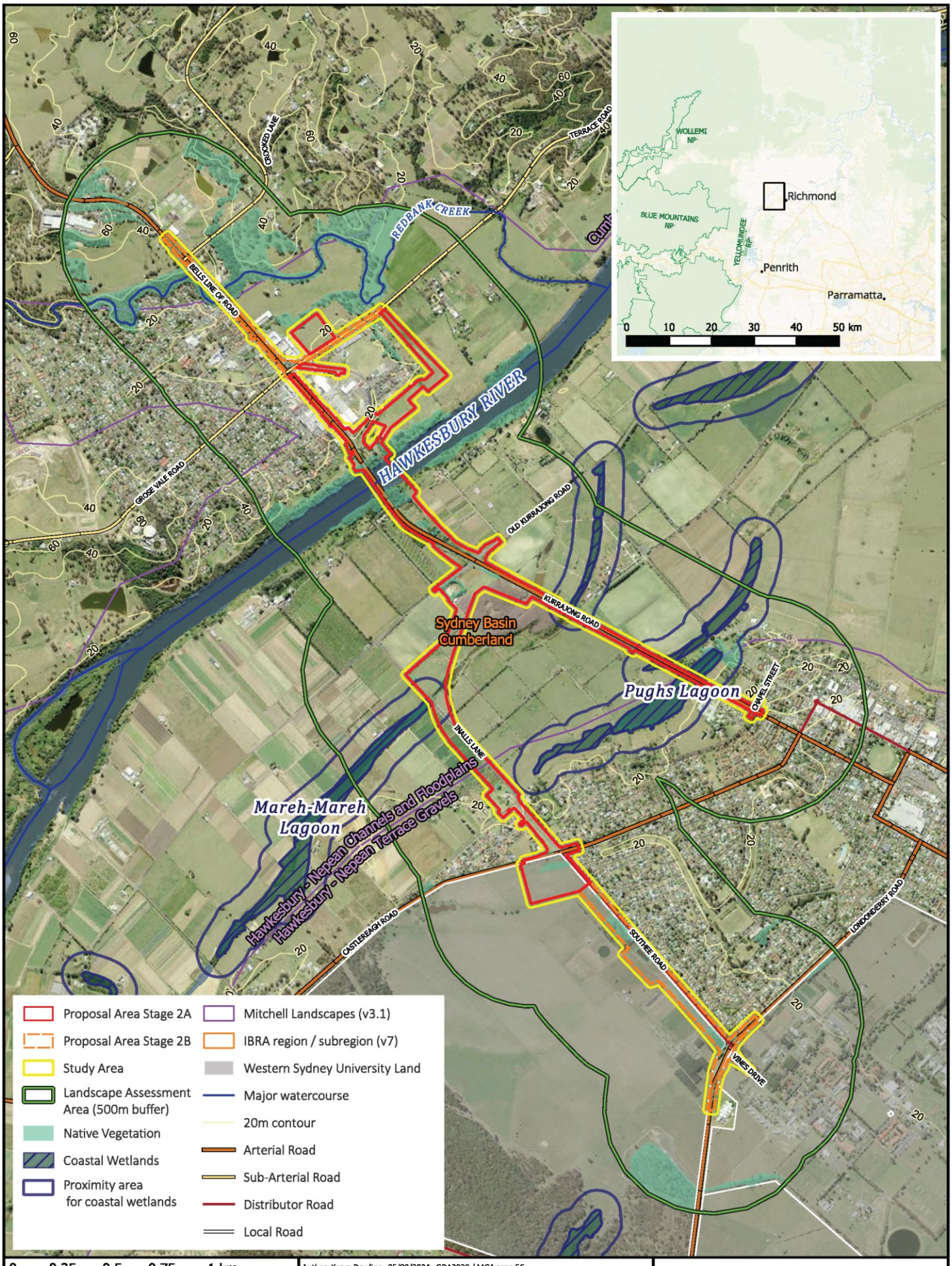

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Figure 1.1: Proposal context

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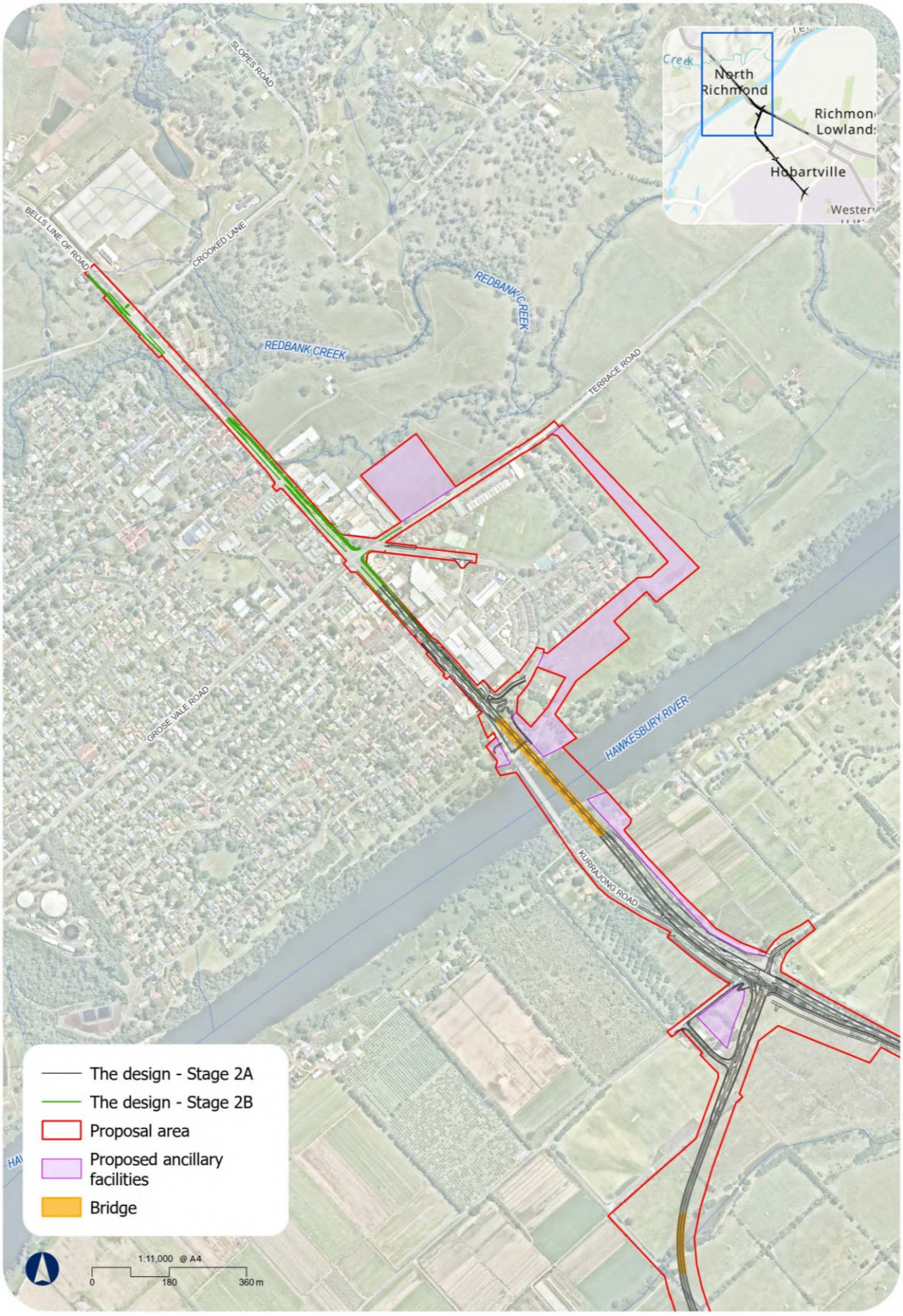

Figure 1.2a: The proposal (Proposal area explained above)

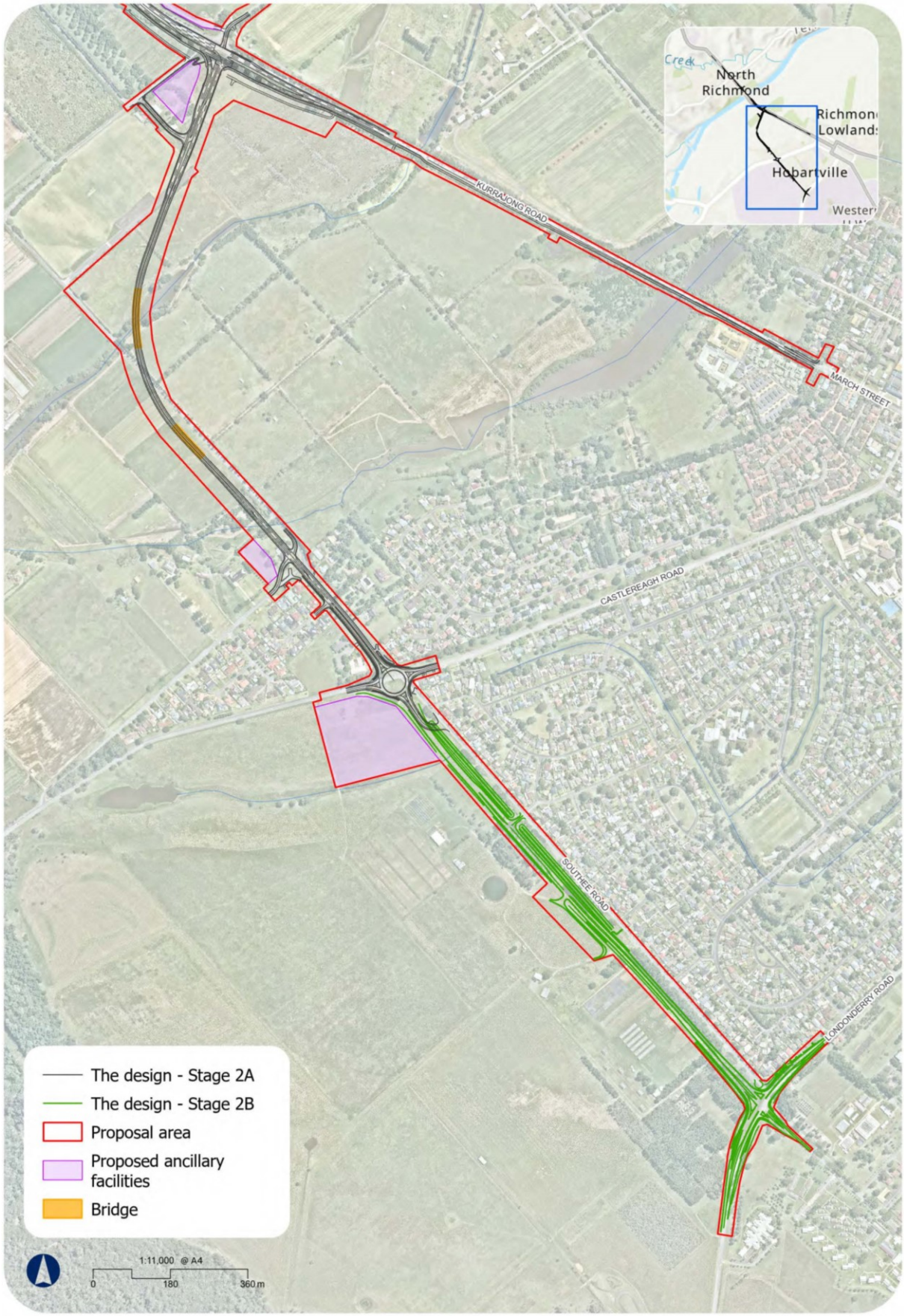

Figure 1.2b: The proposal (Proposal area explained above)

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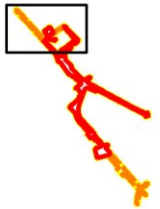

Figure 1.3a: Coastal Wetlands

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Figure 1.3b: Coastal Wetlands

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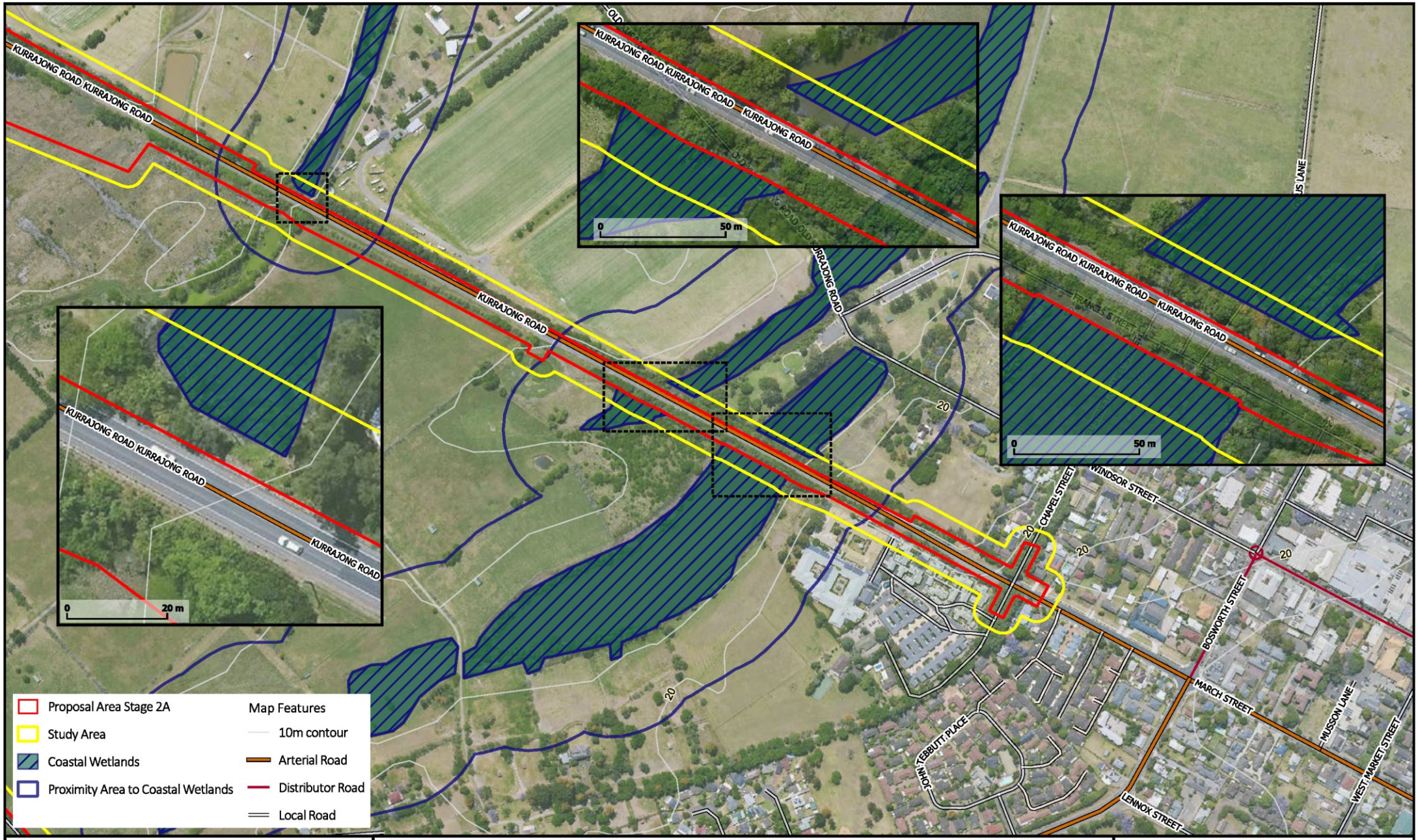

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Figure 1.3c: Coastal Wetlands

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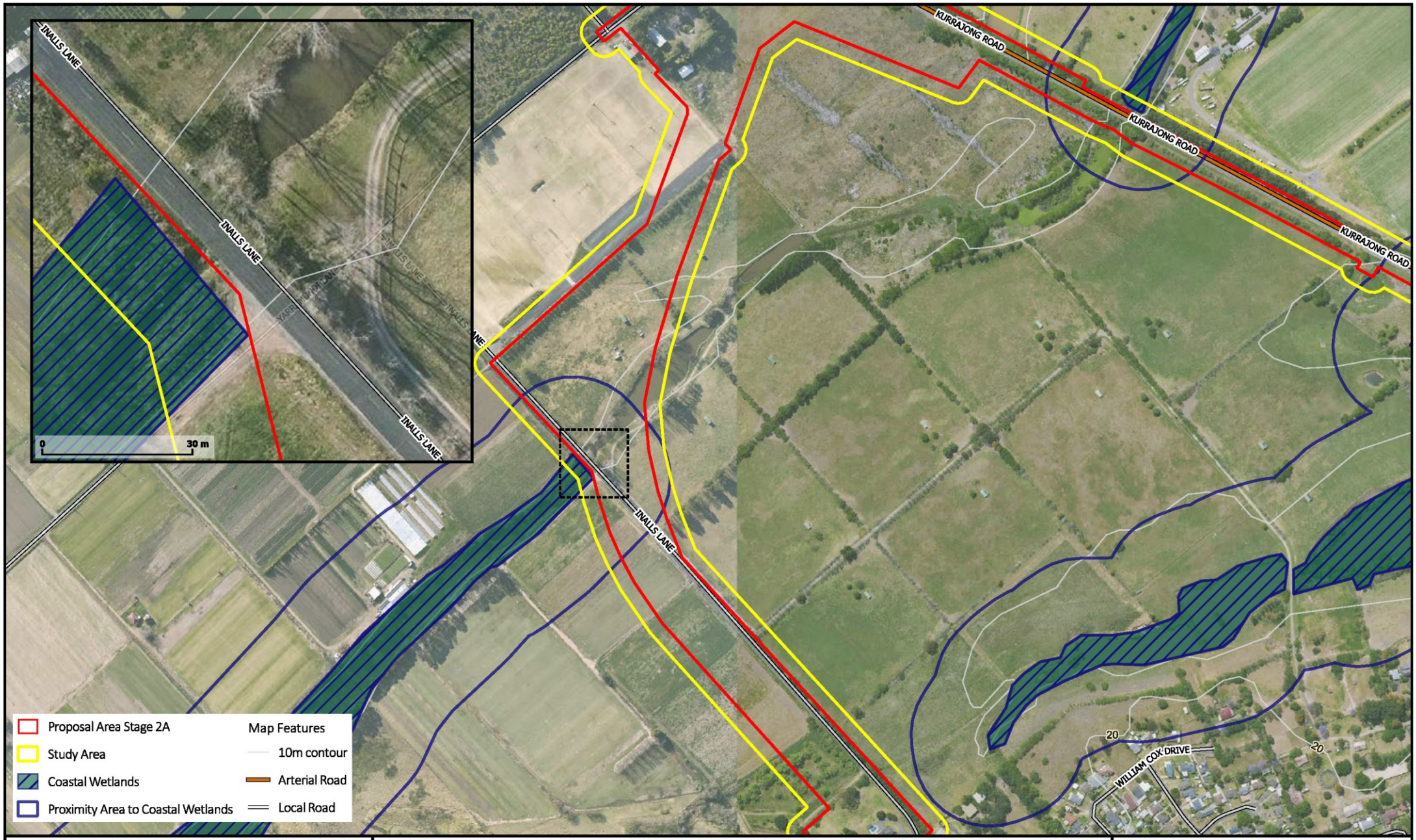

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Figure 1.3d: Coastal Wetlands

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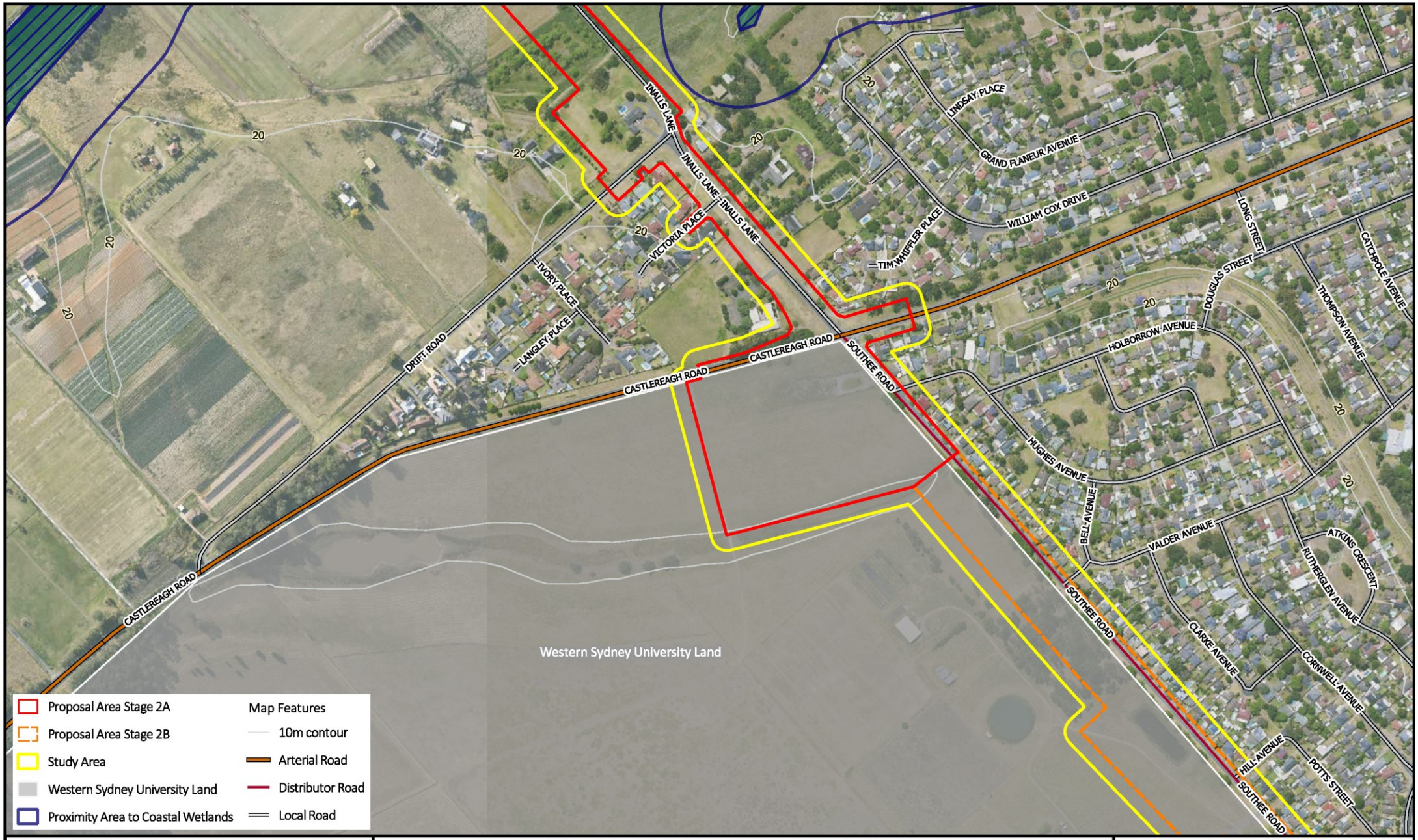

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Figure 1.3e: Coastal Wetlands

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Figure 1.3f: Coastal Wetlands

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1.4 Legislative context

A Review of Environmental Factors (REF) is prepared to satisfy Transport for NSW (Transport) duties under s.5.5 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.5.5 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the New Richmond Bridge and Traffic Improvements Stage 2 and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

The BC Act requires that the significance of the impact on threatened species, populations and threatened ecological communities is assessed using the test listed in Section 7.3 of the BC Act. Similarly, Part 7A of the FM Act requires that significance assessments are undertaken in accordance with Division 12 of the FM Act. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Environment Agency Head's requirements, or a biodiversity development assessment report (BDAR) must be prepared by an accredited assessor in accordance with the biodiversity assessment method (BAM) (DPIE 2020a).

In September 2015, a 'strategic assessment' approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Transport road activities being assessed under Division 5.1 (formerly 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 road proposals assessed via an REF:

- Must address and consider potential impacts on EPBC Act 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 Department of Climate Change, Energy, the Environment and Water (DCCEEW) for these matters, even if the activity is likely to have a significant impact
- Must use the Biodiversity Assessment Method (BAM) to calculate credits that will offset significant impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species.

Assessments of impact significance are required for all relevant biodiversity values in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of Environment (DoE) 2013).

2. Methods

2.1 Personnel

Personnel involved in the assessment and an overview of their qualifications and experience is included in Table 2-1.

Table 2.1: Personnel

Name	Role	Qualifications
George Plunkett (primary author)	Senior Ecologist (flora) – technical lead, flora survey, primary report author	BAM accredited assessor (BAAS19010) B.Sc. (Hons). PhD.
Mark Dean	Senior Ecologist (fauna) – flora & fauna survey, acoustic recorder / camera analysis	BAM accredited assessor (BAAS24008) B.Env.Sc. & Mgt
Debbie Plunkett	Ecologist – flora survey, data management	B.Nat.Res (Hons)
Rachel Neal	Ecologist – flora & fauna survey	B. BSc. (Hons)
Ashley Owen	Ecologist – reporting assistance	DipSc. & BSc (Ecology) BAM Accredited Assessor (BAAS21020)
Kane Blundell	GIS Analyst – mapping, GIS data management	Grad. Dip. Sp.Sci. (in progress)
Keryn Dowling	GIS Analyst – mapping, GIS data management	B.Env.Sci.(Hons) PhD

2.2 Background research

Prior to field inspection, background research was conducted to inform the presence or likelihood of occurrence of the following within the study area and nearby locality :

- Threatened terrestrial and aquatic species and their habitat
- Threatened ecological communities
- Important habitat for migratory species
- Areas of outstanding biodiversity value

The following threatened species databases, previous ecological studies and vegetation mapping resources were reviewed:

- BioNet - the website for the Atlas of NSW Wildlife and Threatened Biodiversity Data Collection (TBDC) – searched 24/11/2023 to 10 km from the proposal area
- BioNet Vegetation Classification database – reviewed 24/11/2023.
- BAM calculator (BAM-C) – predicted and candidate species associated with recorded PCTs
- Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool – searched 24/11/2023 to 10 km from the proposal area
- NSW DPI Fisheries Spatial Data Portal to 10 km from the proposal area
- Regional vegetation mapping within the locality: State Vegetation Type Map (release C1.1)
- Commonwealth Atlas of Groundwater Dependent Ecosystems (GDE) within the locality: GDE Atlas Map: Water Information: Bureau of Meteorology (bom.gov.au).
- National Flying-fox monitoring viewer (environment.gov.au) to 10 km from the proposal area.

- Coastal management within the locality areas identified by the Resilience and Hazards SEPP 2022.
- Core Koala Habitat within the locality identified by the Biodiversity and Conservation SEPP 2022.
- Flora and Fauna assessment for Richmond System Wastewater Upgrades, prepared by Biosis for Sydney Water (November 2021).
- New Richmond Bridge and traffic improvements – Stage 1 The Driftway Biodiversity Assessment Report, prepared by Jacobs Group for Transport for NSW (November 2021)
- The preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the NSW Threatened Species Scientific Committee website (accessed 27/11/2023).
- 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 were viewed on the Commonwealth DCCEEW website (accessed 27/11/2023).

2.3 Vegetation assessment

Vegetation survey and assessment was completed in accordance with Chapter 4 of the Biodiversity Assessment Method (BAM; DIPE 2020a).

2.3.1 Vegetation mapping

Vegetation mapping within the landscape assessment area followed the BAM and associated guidelines. Remnant native vegetation was allocated to the best fit PCT, as detailed in Section 3.1. Planted native vegetation and non-native vegetation were also mapped and assessed according to the BAM. Boundaries of woodland or forest vegetation were mapped to the dripline of trees using the most current aerial imagery (01/08/23 for eastern portion, 21/10/23 for the western portion). Near-infrared spectroscopy (NIRS) was also used to assist in mapping as this provides clearer distinction between different vegetation types. “Native vegetation” has been identified as defined in Section 1.6 of the *Biodiversity Conservation Act 2016* (BC Act) and Part 5A 60B of the *Local Land Services Act 2013* (LLS Act) as follows:

(1) For the purposes of this Part, native vegetation means any of the following types of plants native to New South Wales—

a) trees (including any sapling or shrub or any scrub),

b) understorey plants,

c) groundcover (being any type of herbaceous vegetation),

d) plants occurring in a wetland.

(2) A plant is native to New South Wales if it was established in New South Wales before European settlement. The regulations may authorise conclusive presumptions to be made of the species of plants native to New South Wales by adopting any relevant classification in an official database of plants that is publicly accessible.

(3) For the purposes of this Part, native vegetation extends to a plant that is dead or that is not native to New South Wales if—

e) the plant is situated on land that is shown on the native vegetation regulatory map as category 2-vulnerable regulated land, and

f) it would be native vegetation for the purposes of this Part if it were native to New South Wales.

(4) For the purposes of this Part, native vegetation does not extend to marine vegetation (being mangroves, seagrasses or any other species of plant that at any time in its life cycle must inhabit water other than fresh water). A declaration under section 14.7 of the Biodiversity Conservation Act 2016 that specified vegetation is or is not marine vegetation also has effect for the purposes of this Part

Prior to surveys, an assessment of the NSW State Vegetation Type Map (SVTM) was undertaken to inform likely vegetation types, locations for plot-based survey effort and inform the habitat assessment by identifying threatened species associated with mapped PCTs. The SVTM identified the following PCTs within the study area and nearby:

- PCT 3320 Cumberland Shale Plains Woodland
- PCT 3321 Cumberland Shale-Sandstone Ironbark Forest

- PCT 4024 Cumberland Blue Box Riverflat Forest
- PCT 4025 Cumberland Red Gum Riverflat Forest
- PCT 3975 Southern Lower Floodplain Freshwater Wetland
- PCT 3145 Cumberland Bangalay x Blue Gum Riverflat Forest

2.3.2 Vegetation survey and classification

Vegetation zones

Within the study area, PCT have been delineated into vegetation zones based on broad condition states. Disturbance to growth form groups for tree, shrub and ground cover or extent of exotics (or combinations of these) have been used to identify areas of similar condition. The criteria in the following table were provided in the Transport Template for Biodiversity Assessment Report (BAR) for REFs and have been used to identify areas of low condition vegetation.

Table 2.2: Criteria for assessing vegetation in low condition without a vegetation integrity score

Cat	Vegetation formation	Criteria
A	Rainforest Wet-sclerophyll forest Dry-sclerophyll forest Grassy woodland Forested wetland	Native tree cover <25 % of the tree cover benchmark for the PCT. **AND** Less than 50% of ground cover vegetation consists of either: • *species listed in the BioNet Vegetation Classification PCT profile for medium to high classification confidence PCTs;* ***or*** • *any native species for very low to low classification confidence PCTs.* **OR** Greater than 90% of ground cover vegetation is cleared.
B	Arid Shrubland Heathland Or any PCT from category A where the tree cover benchmark is <10 %	Native shrub cover <50 % of the shrub cover benchmark for the PCT. **AND** Less than 50% of ground cover vegetation consists of either: • *species listed in the BioNet Vegetation Classification PCT profile for medium to high classification confidence PCTs;* ***or*** • *any native species for very low to low classification confidence PCTs.* **OR** Greater than 90% of ground cover vegetation is cleared.
C	Freshwater Wetland Saline Wetland Grassland Alpine Complex Or any PCT from category B where the shrub cover benchmark is <10 %	Less than 50% of ground cover vegetation consists of either: • *species listed in the BioNet Vegetation Classification PCT profile for medium to high classification confidence PCTs;* ***or*** • *any native species for very low to low classification confidence PCTs.* **OR** Greater than 90% of ground cover vegetation is cleared.

Plot-based vegetation survey

Plot-based full floristic survey was completed in accordance with subsection 4.3.4 of the BAM. In addition to the plot data that must be collected (as described by the BAM), Transport also requires the number of trees in each stem size class to be counted in each plot. This data has been used to provide a representative sample of tree counts in each vegetation zone and an

estimate of tree replacement requirements where applicable in accordance with the Transport Tree and Hollow Replacement Guidelines (EMF-BD-GD-0129) – see Section 7.2 of this BAR.

Table 2.3 lists the minimum number of plots required per hectare for each vegetation zone. Table 2.4 and identifies the number of plots undertaken within each vegetation zone. Plots have also been undertaken in areas of non-native and planted native vegetation to inform where no PCT determination can be made. A total of 15 plots were conducted, 13 being standard dimensions of 20 metres x 50 metres, while two were 10 metres x 100 metres to allow for narrow vegetation adjacent to the lagoons. Adjustment of plot dimensions where required is allowed in accordance with subsection 4.3.4 of the BAM. Plot locations are mapped on Figure 2.2.

Table 2.3: Minimum number of plots required per zone area

Vegetation zone area (ha)	Minimum number of plots/midlines
<2	1 plot/midlines
>2-5	2 plots/midlines
>5-20	3 plots/midlines
>20-50	4 plots/midlines
> 50–100	5 plots/midlines
> 100–250	6 plots/midlines
> 250–1000	7 plots/midlines; more plots may be needed if the condition of the vegetation is variable across the zone.
> 1000	8 plots/midlines; more plots may be needed if the condition of the vegetation is variable across the zone.

Table 2.4: Minimum number of plots required and completed per vegetation zone

Veg zone	PCT	Condition	Area (ha)	No. plots required	No. plots completed (plot IDs)
Zone 1	3320 Cumberland Shale Plains Woodland	Low-moderate	0.34	1	2 plots (Plots: 1 & 2)
Zone 2	4025 Cumberland Red Gum Riverflat Forest	Low-moderate	1.36	1	1 plot (Plot 9)
Zone 3	3975 Southern Lower Floodplain Freshwater Wetland	Low-moderate	0.55	1	2 plots (Plots 11 & 14)
Zone 4	Planted native vegetation	Low	3.87	2	3 plots (Plots 4, 7 &15)
Zone 5	Exotic trees and shrubs	Low	8.50	3	4 plots (Plots 5, 10, 12 & 13)
Zone 6	Exotic pasture and lawn	Low	35.32	4	3 plots* (Plots 3, 6 & 8)

*Completed plots are fewer than the required four plots due to the post-survey addition of area identified on Figure 2.4. Sampled plots are considered to adequately capture the vegetation within this zone, and plots within exotic pasture are not strictly required under Transport guidelines.

2.3.3 Patch size

Patch size was calculated for each vegetation zone containing remnant vegetation in accordance with Section 4.3.2 of the BAM. Patch size is calculated as the total area of native vegetation connected to the proposal area according to one of the following classes:

- <5 hectares
- 5-<25 hectares
- 25-<100 hectares
- ≥100 hectares.

Patch size mapping is shown on Figure 2.1. Vegetation Zones 1 and 2 were assigned to patch size class ≥100 hectares, while Vegetation Zone 3 was assigned to patch size class 25-<100 hectares.

2.3.4 Native vegetation cover

Native vegetation cover was calculated in accordance with Section 3.2 of the BAM. SVTM mapping was used to measure native vegetation within the assessment area buffered 500 metres from the proposal area (Figure 1.1; Table 2.5). A 500-metre buffer was used to define the assessment area rather than the standard 1500-metre buffer as the proposal is a linear project.

Table 2.5: Native vegetation cover in the assessment area

Assessment area (ha)	980.94
Total area of native vegetation cover (ha)	77.88
Percentage of native vegetation cover (%)	8.6%
Class (0-10, >10-30, >30-70 or >70%)	0–10%

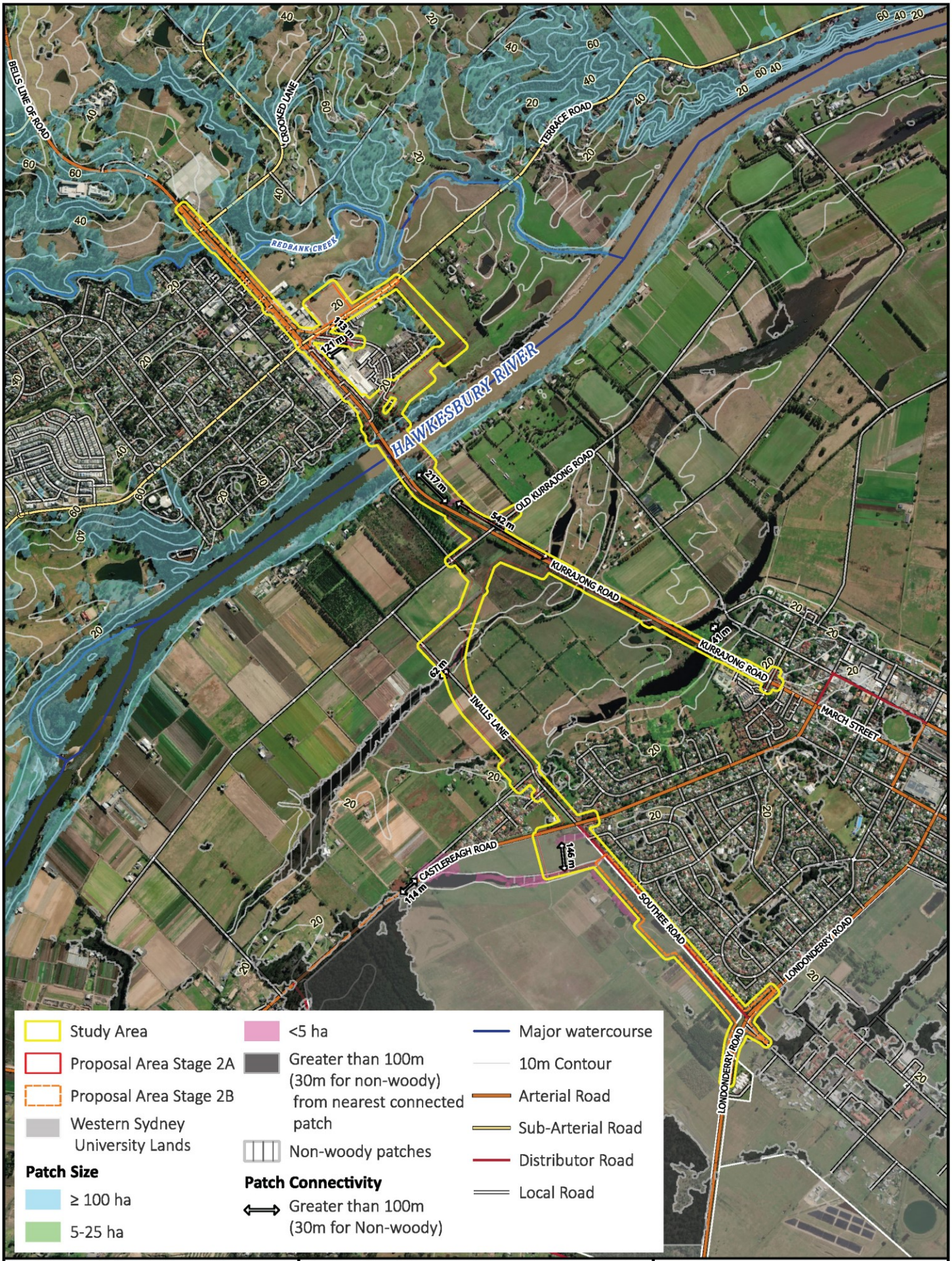

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Figure 2.1: Patch Size and Connectivity

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2.4 Threatened species assessment

Threatened species assessment was conducted in alignment with Chapter 5 of the BAM. This requires that a list of species is produced as would be generated by the BAM-C in association with the PCTs within the proposal area. For this BAR, the PCT associations within the Bionet Vegetation Classification power query database were used to effectively produce the same credit species associations as would be produced by the BAM-C. Threatened species are separated into two groups for assessment:

- 'Ecosystem-credit' species listed only under the BC Act – these species are assessed by habitat suitability assessment and do not strictly require targeted surveys.
- 'Species-credit' species listed under the BC Act and any species listed under the EPBC Act – any of these species that are associated with PCTs (as defined by the TBDC and BAM-C) being impacted and have a moderate to high likelihood of occurrence (an outcome of Appendix B: Habitat suitability assessment) should be targeted by surveys in accordance with applicable guidelines. This is a slight variation to Chapter 5 of the BAM that requires targeted survey for all species-credit species identified by the BAM-C.

Targeted surveys for species-credit species followed relevant BAM guidelines and/or information provided in the TBDC for each species.

In accordance with the BAM, targeted survey is not required for ecosystem-credits species and is only required for dual-credit species where breeding habitat has been identified. For these, EPBC Act species that are being assessed as ecosystem-credit species (this includes dual-credit species where there is no breeding habitat), Commonwealth guidelines are considered noting that survey is unlikely to be required and presence may be assumed (noting that Transport offset thresholds only apply to species credit species). Commonwealth survey requirements are considered for species listed under the EPBC Act that are not listed under the BC Act.

2.4.1 Habitat suitability assessment

A list of threatened species and populations that have been reported or modelled to occur within a 10-kilometre radius of the study area was obtained from the following databases:

- NSW Department of Planning, Industry and Environment (DPIE) BioNet Atlas http://www.bionet.nsw.gov.au/.
- Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) https://www.environment.gov.au/epbc/protected-matters-search-tool.

Predicted and candidate species associated with the recorded PCTs were also included in this list based on the PCT associations within the Bionet Vegetation Classification power query database. This provides the same credit species associations as would be produced by the BAM-C.

An assessment was made as to the likelihood of any of the reported matters occurring within the study area or using the habitat as an essential part of their foraging range based on information available concerning habitat requirements of threatened species, populations and ecological communities. Strictly pelagic and marine species were excluded from the analysis due to lack of habitat within the study area. The habitat suitability assessment is provided in Appendix B: Habitat suitability assessment.

2.4.2 Targeted flora surveys

Following habitat suitability assessment, targeted flora surveys were conducted for species with a potential to occur of moderate to high. Species with unlikely potential to occur do not require survey following the Transport threatened species assessment requirements.

Parallel field traverses were undertaken within areas of suitable habitat. Surveys were conducted in accordance with the following survey guides:

- DPIE (2020c), Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method.
- Commonwealth of Australia (2013b) Draft survey guidelines for Australia's threatened orchids (awe.gov.au).

Flora survey methods are summarised in Table 2.6, and field traverses shown on Figure 2.2.

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Figure 2.2a: Flora survey effort

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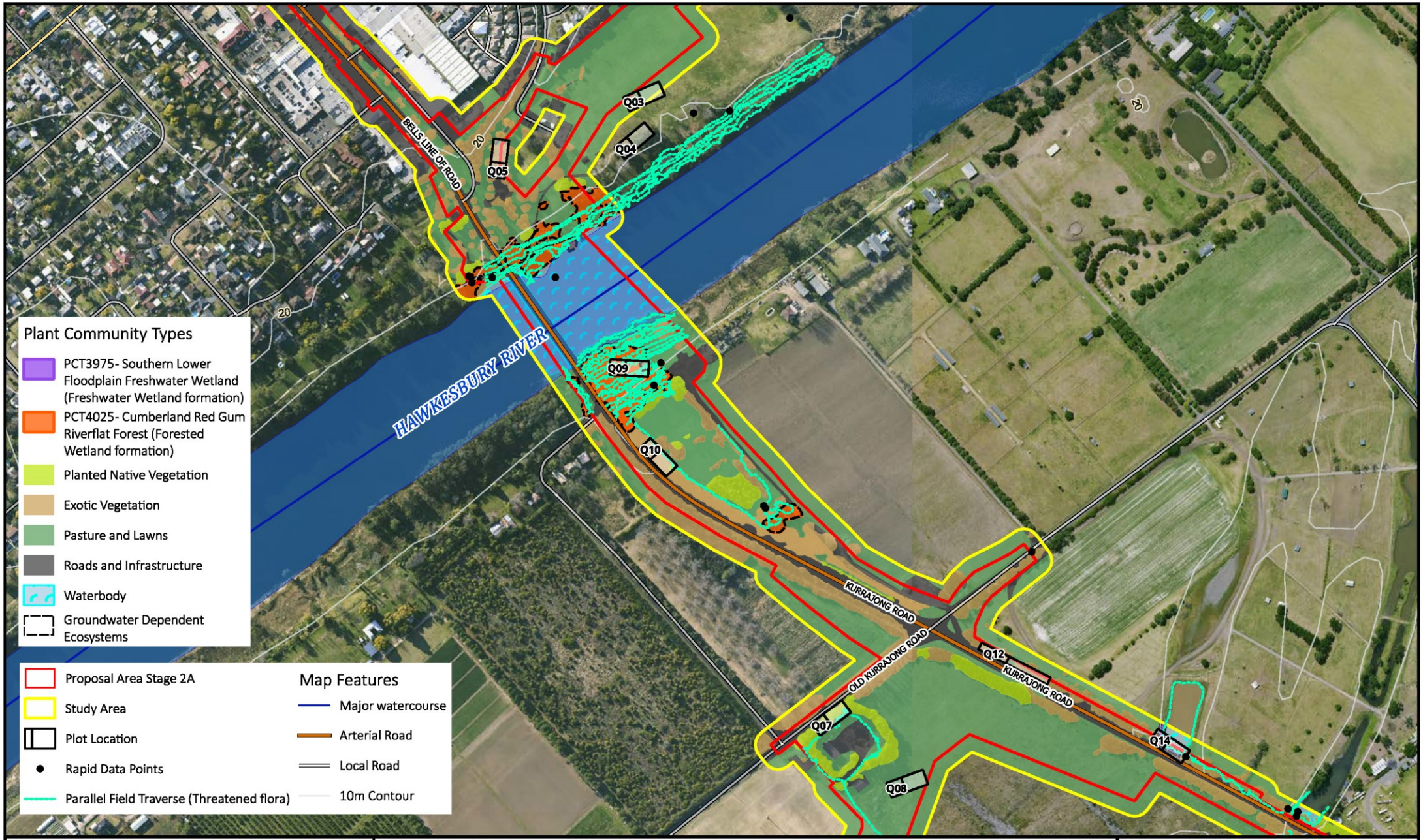

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Figure 2.2b: Flora survey effort

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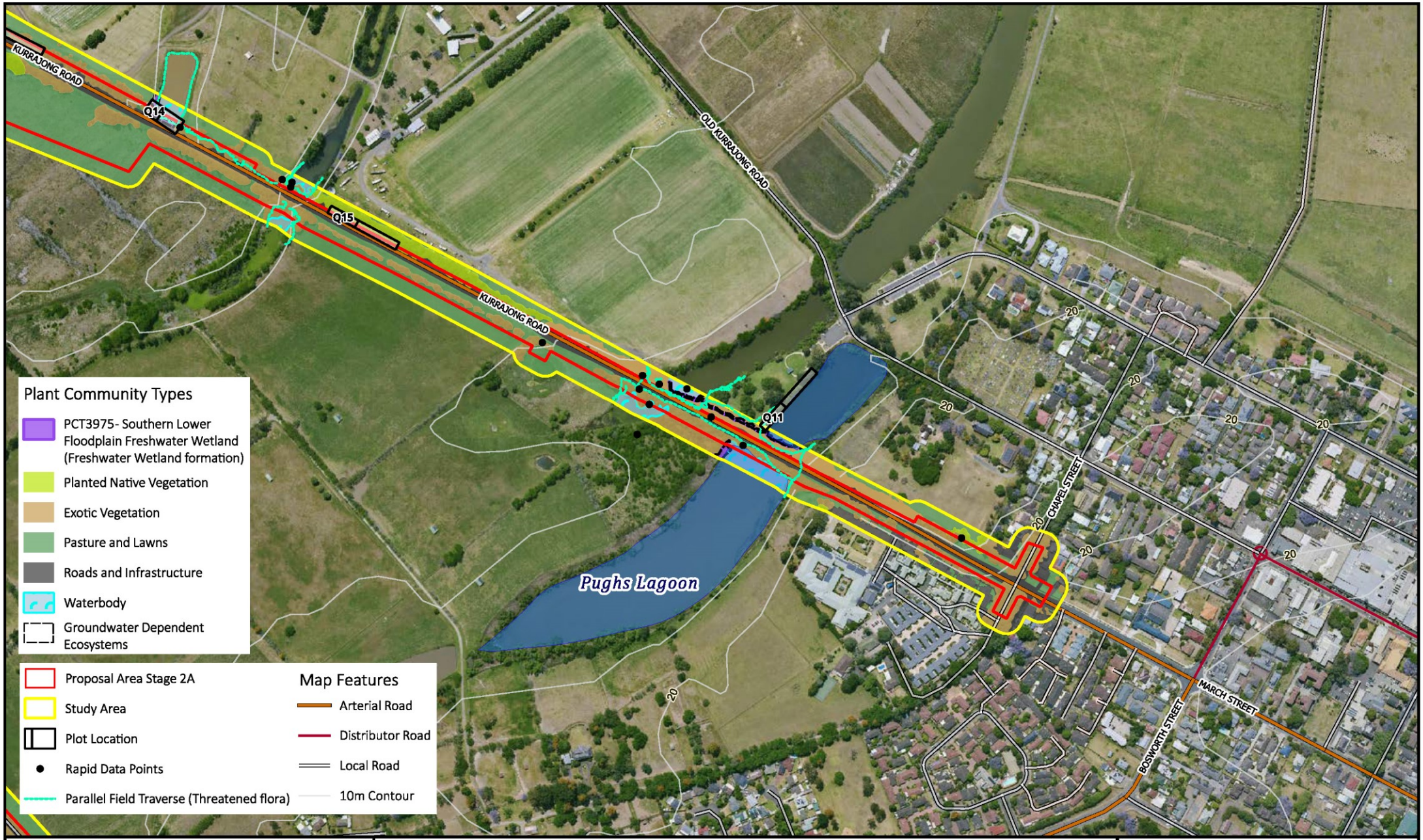

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Figure 2.2c: Flora survey effort

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Figure 2.2d: Flora survey effort

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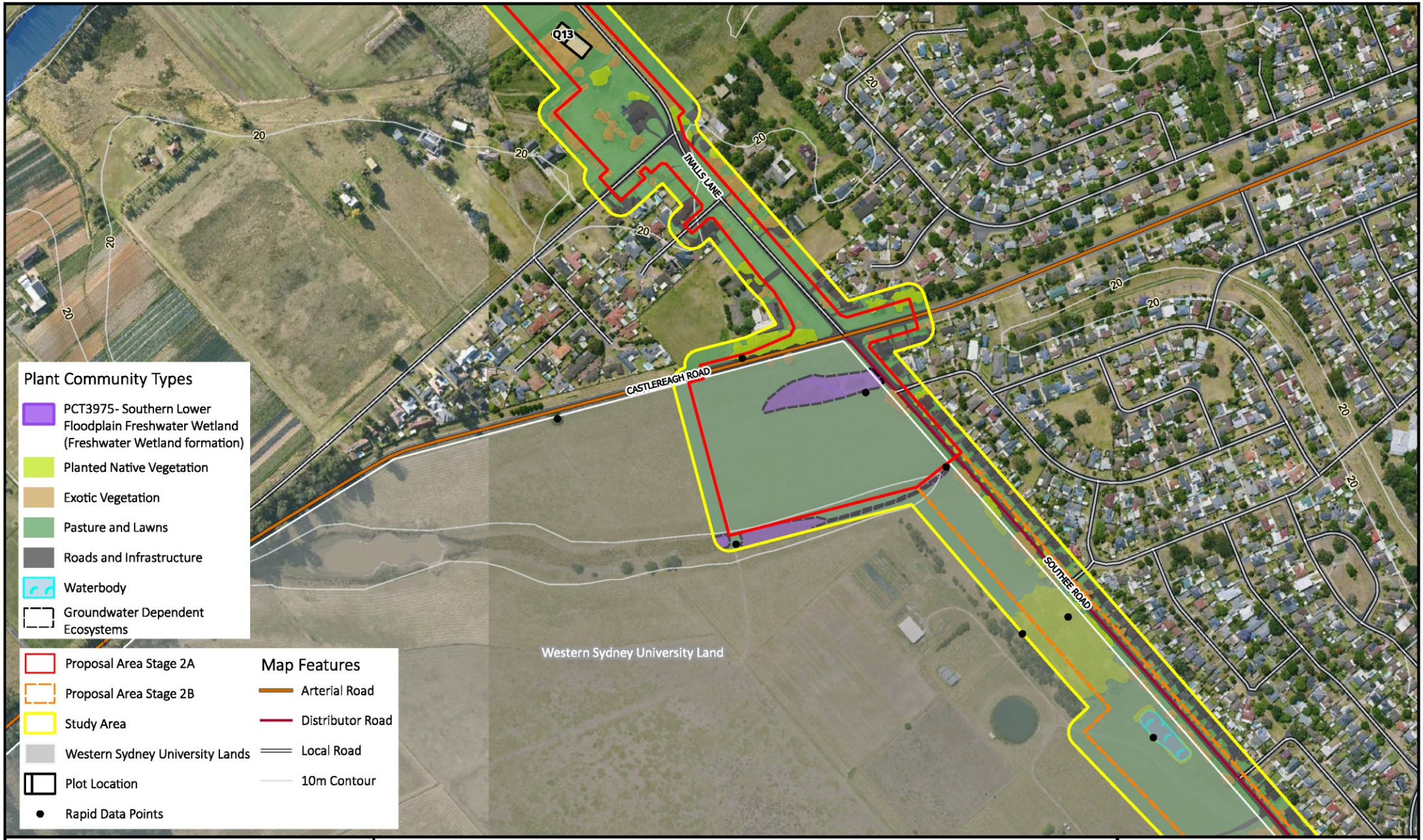

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Figure 2.2e: Flora survey effort

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Figure 2.2f: Flora survey effort

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Table 2.6: Targeted threatened flora survey details

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
Acacia pubescens **Downy Wattle**	All months	PCT 3320	Parallel field traverse 10 m apart	Parallel field traverse 5 m apart completed within PCT 3320 in October 2023.
Cynanchum elegans **White-flowered Wax Plant**	All months	Associated with same vegetation formations as PCTs 3320, 4025.	Parallel field traverse 5 m apart	Parallel field traverse 5 m apart completed within PCTs 3320 and 4025 in October 2023.
Eucalyptus benthamii **Camden White Gum**	All months	PCTs 3320, 4025	Parallel field traverse 20 m apart	Parallel field traverse 5 m apart completed within PCTs 3320 and 4025 in October 2023.
Grevillea juniperina **subsp. *juniperina*** **Juniper-leaved Grevillea**	All months	PCTs 3320, 4025	Parallel field traverse 10 m apart	Parallel field traverse 5 m apart completed within PCTs 3320 and 4025 in October 2023.
Haloragis exalata **subsp. *exalata*** **Square Raspwort**	All months	Associated with same vegetation formations as PCTs 3975, 4025.	Parallel field traverse 5 m apart	Parallel field traverse 5 m apart completed within PCTs 3975 and 4025 in October 2023.
Hibbertia puberula	Oct–Dec	PCT 3320	Parallel field traverse 5 m apart. Survey when temperature is below 25°C (drops petals at higher temperatures).	Parallel field traverse 5 m apart completed within PCT 3320 in October 2023. Temperatures were above 25°C (33.9°C and 30°C recorded by BOM), but no *Hibbertia* or shrub species were observed that could possibly have been *H. puberula.* Additionally, the highly disturbed and weedy condition of the proposal area indicate that this species is not likely to occur.
Persicaria elatior **Tall Knotweed**	Dec–May	PCT 3975	Parallel field traverse 5 m apart	Parallel field traverse completed within PCT 3975 in November. Although outside of the defined survey period, it can be identified without flowers due to the presence of stalked glandular hairs on most parts of the plant. *Persicaria* species were observed during targeted survey, but were easily identified as common species (*P. decipiens* and *P. lapathifolia*). No *P. elatior* were observed.
Persoonia hirsuta **Hairy Geebung**	All months	PCT 4025	Parallel field traverse 10 m apart	Parallel field traverse completed within PCT 4025 in October 2023.
Pimelea spicata **Spiked Rice-flower**	All months	PCTs 3320 and 4025	Parallel field traverse 5 m apart. Survey 4	Parallel field traverse 5 m apart completed within PCTs 3320 and 4025 in October 2023. No

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
			weeks after at least a 30 mm rainfall event. In drier times plants are often not visible above ground unless soils remain moist. Survey at least 3 times, each at least a month apart unless found.	30 mm rainfall events recorded at Richmond in the 4 weeks leading up to survey. The highly disturbed and weedy condition of the proposal area indicate that this species is not likely to occur.
Pterostylis saxicola **Sydney Plains Greenhood**	October	PCT 3320	Parallel field traverse 5 m apart	Parallel field traverse completed within PCT 3320 in October 2023.

2.4.3 Targeted fauna surveys

Following habitat suitability assessment, targeted fauna surveys were conducted for species with a potential to occur of moderate or higher. Species with low or unlikely potential to occur do not require survey following the Transport threatened species assessment requirements.

Surveys were conducted in accordance with the following survey guides:

NSW survey guidelines:

- OEH (2018), 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method.
- DPE (2022b), Koala (Phascolarctos cinereus): Biodiversity Assessment Method Survey Guide | NSW Environment and Heritage
- DPE (2022c), Threatened reptiles: Biodiversity Assessment Method Survey Guide | NSW Environment and Heritage
- Department of Environment and Conservation Threatened Biodiversity Survey and Assessment - Guidelines for Developments and Activities (2004 working draft).

Commonwealth survey guidelines (on the DCCEEW website):

- Commonwealth of Australia (2010a), Survey Guidelines for Australia's Threatened Bats.
- Commonwealth of Australia (2010b), Survey Guidelines for Australia's Threatened Birds.
- Commonwealth of Australia (2011b), Survey Guidelines for Australia's Threatened Mammals..
- Commonwealth of Australia (2011c), Survey Guidelines for Australia's Threatened Reptiles.

Fauna survey methods are detailed below and summarised in Table 2.7, and field traverses shown on Figure 2.3.

Arboreal Mammals

Survey targeting Squirrel Glider was undertaken through installation of 13 Boly Guard remote trigger cameras placed at heights of between 1 and 3 metres (Figure 6) – four within PCT 3320, three within PCT 4025 and six within planted native vegetation. Cameras installed onsite were active for a minimum of 16 days / nights between 31/10/2023 and 17/11/2023. Cameras were baited with a mixture of honey, oats, peanut butter and treacle in a mesh canister. The surrounding area was sprayed with honey water mixture. Images were analysed in-house to identify species captured on camera.

Survey targeting Koala involved SAT surveys (as per Phillips and Callaghan, 2011) in three locations along with spotlighting transects over two nights (31/10/2023 and 1/11/2023) within potential koala habitat (PCT 3320 and PCT 4025) in accordance with DPE (2022b).

Bats

Anabat™ bat-call detectors were used passively to record the calls of passing microbats. Four Anabats™ were set up within suitable microbat habitat and along potential flyways and left to record for three consecutive nights between 30/10/2023 and 2/11/2023. A handheld Anabat™ Walkabout was also used over two nights (31/10/2023, 1/11/2023) targeting water bodies, culverts and bridges to determine whether any bats were using these features.

Roost searches were also conducted during daylight hours targeting culverts and bridges.

Presence of Grey-headed Flying-fox camps was surveyed during diurnal and nocturnal survey between 30/10/2023 and 2/11/2023.

Birds

Habitat assessments (nest and hollow surveys) were conducted throughout the Study Area between 30/10/2023 and 2/11/2023. Surveys targeted suitable, mature hollow-bearing trees and stick-nests suitable for species including Powerful Owl, Glossy Black Cockatoo and Square-tailed Kite. Surveys focused on areas containing large mature trees. Bird observations and nests were also noted during threatened flora searches.

Snails

Targeted habitat searches for Cumberland Plain Land Snail and Dural Land Snail were stratified within the Proposal area targeting the most appropriate areas of habitat within, which included PCT 3320 and PCT 4025. Search transects are shown on Figure 2.3.

Snail survey was conducted on 1-2/11/2023 and involved active searching for live snails and snail shells within litter and around tree bases. Logs, stumps, artificial refuse and rocks were turned over and rotten sections of logs were peeled away. Larger movable logs were specifically targeted.

Where living specimens were located, these were returned and habitat was left nearest to found state. Some dead shell specimens were collected for sample analysis.

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Figure 2.3a: Fauna survey effort

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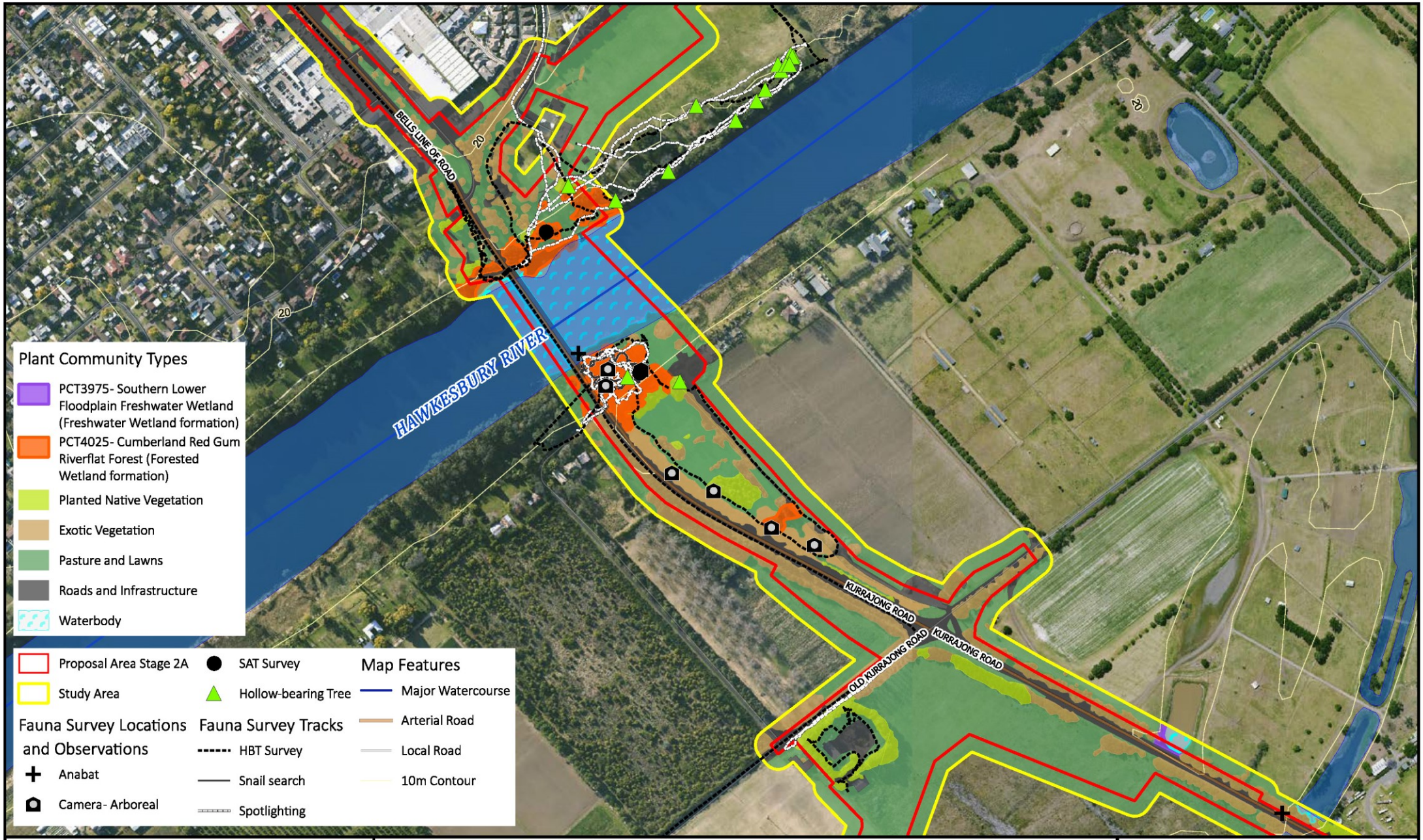

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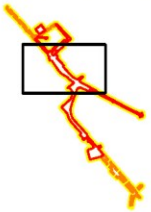

Figure 2.3b: Fauna survey effort

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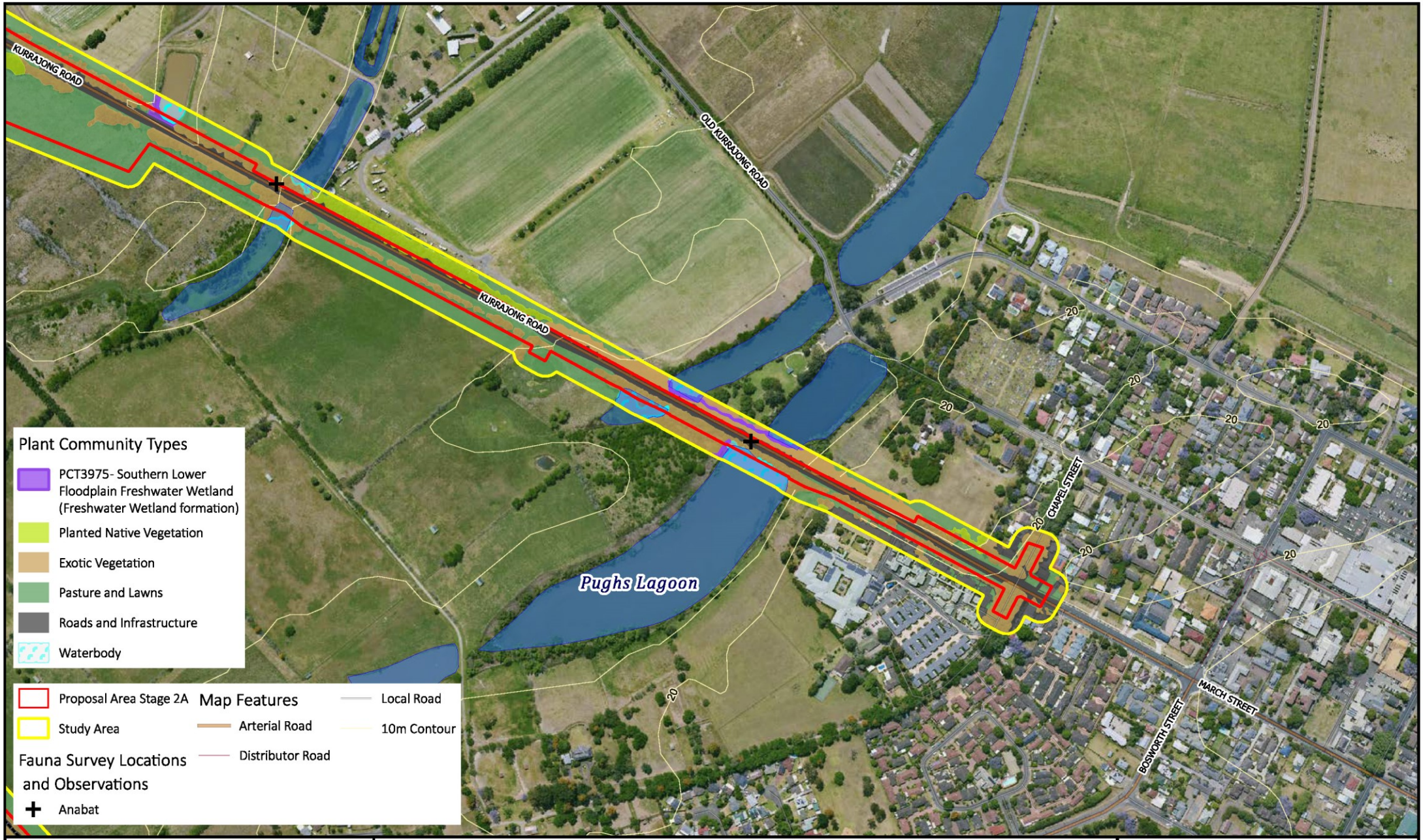

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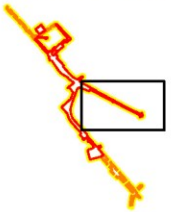

Figure 2.3c: Fauna survey effort

Transport for NSW
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New Richmond Bridge & Traffic Improvements Stage 2

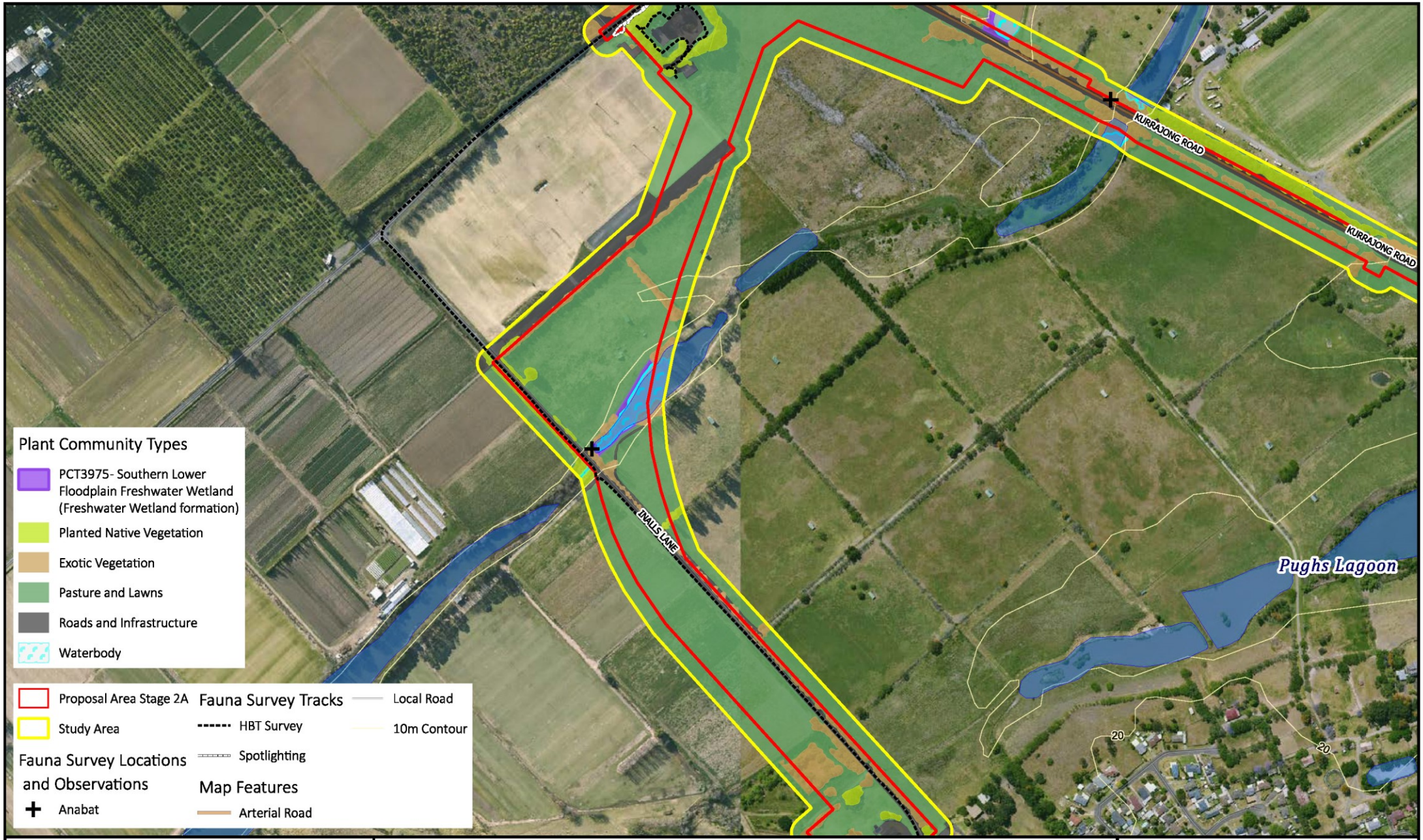

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Figure 2.3d: Fauna survey effort

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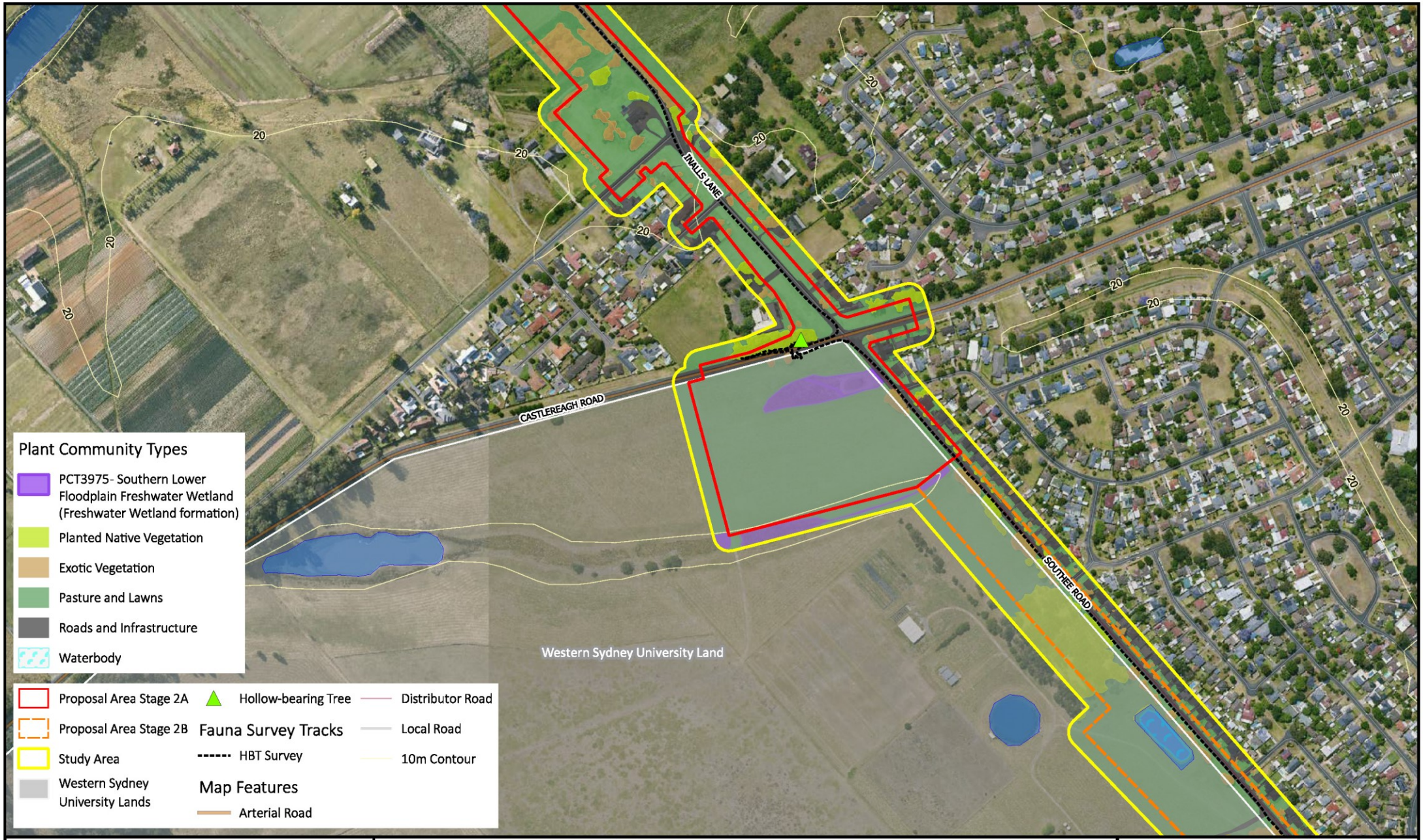

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Figure 2.3e: Fauna survey effort

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Figure 2.3f: Fauna survey effort

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Table 2.7: Targeted threatened fauna survey details

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
Anthochaera phrygia Regent Honeyeater	Dependant on mapped important habitat, which is not mapped on within the study area.	PCTs 3320 and 4025	No survey is required – presence in accordance with the BAM is directly linked to presence of mapped important habitat, which is absent. The species is considered present for any part of the proposal area that is within the important habitat map. Any habitat outside the important areas is assessed for ecosystem credits.	No survey required.
Artamus cyanopterus cyanopterus Dusky Woodswallow	Ecosystem species: no targeted survey required	PCTs 3320 and 4025	Ecosystem species: no targeted survey required	No survey required.
Daphoenositta chrysoptera Varied Sittella	Ecosystem species: no targeted survey required	PCTs 3320 and 4025	Ecosystem species: no targeted survey required	No survey required.
Glossopsitta pusilla Little Lorikeet	Ecosystem species: no targeted survey required	PCTs 3320 and 4025	Ecosystem species: no targeted survey required	No survey required.
Lathamus discolor Swift Parrot	Dependant on mapped important habitat, which is mapped along riverbank.	PCTs 3320 and 4025	No survey is required – presence in accordance with the BAM is directly linked to presence of mapped important habitat, which is mapped along riverbank. The species is considered present for any part of the proposal area that is within the important habitat map. Any habitat outside the important areas is assessed for ecosystem credits.	No survey required - species is assumed present due to important habitat mapping within the proposal area, in accordance with the BAM.
Lophoictinia isura Square-tailed Kite	Nest searches Sept–Dec	PCTs 3320 and 4025	Nest searches conducted October and November 2023	Survey completed – species not detected during nest searches in October and November.
Ninox strenua Powerful Owl	Hollow searches any time. If suitable hollows, survey for breeding presence June–Aug.	PCTs 3320 and 4025	Hollow searches. If suitable hollows, survey for breeding presence.	Hollow searches conducted October and November 2023 – no suitable breeding hollows observed. Survey for breeding presence not required.

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
Oxyura australis Blue-billed Duck	Ecosystem species: no targeted survey required	PCTs 3975	Ecosystem species: no targeted survey required	No survey required.
Stictonetta naevosa Freckled Duck	Ecosystem species: no targeted survey required	PCTs 3975	Ecosystem species: no targeted survey required	No survey required.
Chalinolobus dwyeri Large-eared Pied Bat	Nov–Jan if within 2km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices	All – foraging and roosting habitat only. Recorded culverts do not provide suitable roosting or breeding habitat.	No suitable breeding habitat – site is more than 2 km from rocky areas containing caves, overhangs, escarpments, outcrops or crevices – targeted survey not required under the BAM.	Species not recorded within the Proposal area. Surveys undertaken: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. Roost searches targeting culverts and bridges (31st Oct, 1st Nov).
Falsistrellus tasmaniensis Eastern False Pipistrelle	Ecosystem species: no targeted survey required for BAM	All.	Ecosystem species: no targeted survey required	Recorded within the proposal area. Survey: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. • Roost searches targeting culverts and bridges (31st Oct, 1st Nov).

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
Micronomus norfolkensis Eastern Coastal Free-tailed Bat	Ecosystem species: no targeted survey required for BAM	All. Tree hollows may provide roosting & breeding habitat.	Ecosystem species: no targeted survey required	Recorded within the proposal area. Survey: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. • Roost searches targeting culverts and bridges (31st Oct, 1st Nov).
Miniopterus australis Little Bent-winged Bat	Dec - Feb for breeding only if breeding habitat present.	All – foraging and roosting habitat only. Recorded culverts do not provide suitable roosting or breeding habitat.	No suitable breeding habitat – targeted survey not required under the BAM.	Species not recorded within Proposal area. Surveys undertaken: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. • Roost searches targeting culverts and bridges (31st Oct, 1st Nov).

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
Myotis macropus Southern Myotis	Oct–Mar	All – within 200 m of waterbodies > 3 m width.	Harp trap or mist net or acoustic detection (16 nights min.) Roost searches optional.	Species recorded within the proposal area by acoustic detection. Survey: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. • Roost searches targeting culverts and bridges (31st Oct, 1st Nov).
Petaurus norfolcensis Squirrel Glider	All months	PCTs 3320 and 4025	Infra-red remote cameras installed for 14 days at a density of 2 cameras per PCT.	13 cameras installed for 17 days – 4 within 3320, 3 within 4025, 6 within planted native vegetation.
Phascolarctos cinereus Koala	All months	PCTs 3320 and 4025	Two survey methods must be met[1]: 1. Spot Assessment Technique (SAT) (min. 3 SATs) OR detection dogs 2. Spotlighting OR acoustic detection OR drones [1]Following DPE (2022b)	SAT surveys x3 (31st Oct). Spotlighting transects over 2 nights, 5–50 m apart (31st Oct, 1st Nov).
Pteropus poliocephalus Grey-headed Flying-fox	All months to detect camps. Oct–Dec to assess breeding presence if camps recorded.	All	General diurnal / nocturnal survey Oct–Dec	Diurnal and nocturnal survey Oct and Nov. No breeding camps detected.

Species name	Required survey period	Associated PCTs in the proposal area	Minimum survey requirements[1]	Survey completed
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	Ecosystem species: no targeted survey required for BAM	All. Tree hollows may provide roosting habitat.	Ecosystem species: no targeted survey required	Survey: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. • Roost searches targeting culverts and bridges (31st Oct, 1st Nov).
Scoteanax rueppellii Greater Broad-nosed Bat	Ecosystem species: no targeted survey required for BAM	All. Tree hollows may provide roosting habitat.	Ecosystem species: no targeted survey required	Recorded within the proposal area. Survey: • Passive acoustic detectors (4 units for 3 nights; 30th Oct–2nd Nov). • Handheld acoustic detector over 2 nights (31st Oct, 1st Nov) targeting water bodies, culverts and bridges. • Roost searches targeting culverts and bridges (31st Oct, 1st Nov).
Meridolum corneovirens Cumberland Plain Land Snail	All months.	PCTs 3320 and 4025	Searches in leaf litter and around tree bases for live snails and shells.	Searches in leaf litter and around tree bases for live snails and shells, conducted in Oct and Nov 2023.
Pommerhelix duralensis Dural Land Snail	All months.	PCTs 3320 and 4025	Searches in leaf litter and around tree bases for live snails and shells.	Searches in leaf litter and around tree bases for live snails and shells, conducted in Oct and Nov 2023.

2.4.4 Aquatic habitat assessment

No aquatic surveys were undertaken as part of this assessment. Aquatic environments within and adjacent to the proposal area do not provide potential habitat for any threatened species (see Appendix B: Habitat suitability assessment). Database review of threatened fish species habitat and distribution identified two species with potential to occur in the locality:

- Macquarie Perch (Vulnerable FM Act; Endangered EPBC act)
- Australian Grayling (Protected Fish FM Act; Vulnerable EPBC Act)

The proposal area does not provide habitat for these species, which require clear-flowing water, and is outside of both species' distribution. Macquarie Perch distribution is restricted to upstream of the junction of the Nepean and Grose Rivers. Australian Grayling distribution does not extend to the Cumberland Plain, the northernmost limit being the Shoalhaven River.

An aquatic desktop assessment was conducted to assess the Hawkesbury River, Redbank Creek and lagoons within the study area 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 desktop only and no fish surveys or macroinvertebrate surveys were conducted; nor was water quality sampling undertaken. This approach is appropriate as the study area is not considered suitable for any threatened fish species, as noted above. The aim of the habitat assessment was to identify the presence of 'Key Fish Habitat'.

Searches of the following databases, existing mapping and other literature were used to aid the assessment:

- Fisheries Spatial Data Portal
- Protected Matters Search Tool
- Atlas of GDEs (Bureau of Meteorology)
- SEPP (Resilience and Hazards) 2022 – Interactive map viewer
- Australian Wetlands Database (Department of the Environment and Energy, 2019).

The proposal crosses over the Hawkesbury River and is located close to areas mapped under the Resilience and Hazards SEPP (2022) as 'Coastal Wetlands' (Figure 1.3). The proposal occurs within areas mapped as 'Coastal Wetlands Proximity Areas (100-metre buffer)' under the Resilience and Hazards SEPP (2022) (see Section 3.8.1). These areas are associated with Pughs Lagoon and associated lagoons, and tributary lagoons to Mareh-Mareh Lagoon. These lagoons are not listed as RAMSAR Wetlands or Wetlands of National Importance. The proposal area also passes over Redbank Creek but no works are proposed in that area.

The waterways were broadly assessed in accordance with Table 1 of the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and Table 1 of *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), and the outcomes of this assessment are presented in Table 2.8.

Table 2.8: Outcomes of aquatic habitat assessment

Waterway	Key Fish Habitat type and sensitivity (DPI, 2013)	Waterway class (Fairfull and Witheridge, 2003)
Hawkesbury River	Type 1 – Highly sensitive	Class 1 – Major fish habitat
Redbank Creek	Type 1 – Highly sensitive	Class 2 – Moderate fish habitat

2.5 Limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the proposal area at that time of survey. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the proposal area outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

Flora survey limitations

The species list does not include all household or exotic garden and landscaping species and those species which could not be identified at the time of the survey past genus level. Cryptic common species not flowering at the time of the survey may not be observed during survey outside of peak flowering periods.

Survey was not conducted in an extension area that was included within the proposal area following site inspection (see blue area in Figure 2.4). Vegetation mapping within this area was based on desktop assessment utilising aerial imagery, Google Streetview, and previous survey by Biosis (2021). Targeted threatened flora survey and plot-based survey was also not able to be conducted within the WSU lands due to lack of access (blue area in Figure 2.5). These areas are highly modified and provide very low potential habitat for any threatened flora. General vegetation and hollow-bearing tree (HBT) surveys were conducted along Southee Road, the eastern side of which provides no suitable habitat for threatened species. Assumptions have been made in this BAR regarding the likely presence of threatened species in the absence of survey within this area.

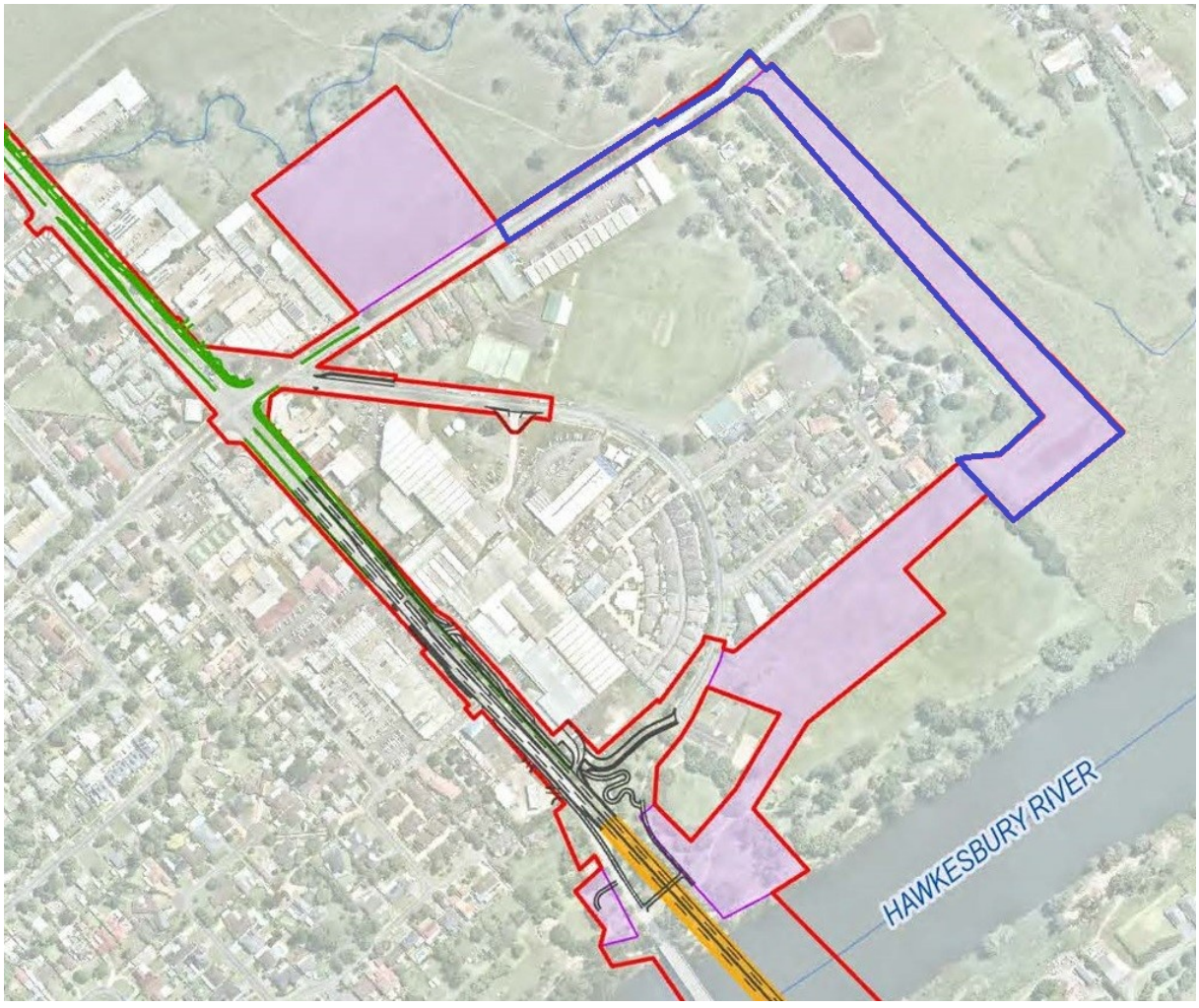

Figure 2.4: Area excluded from all survey (blue)

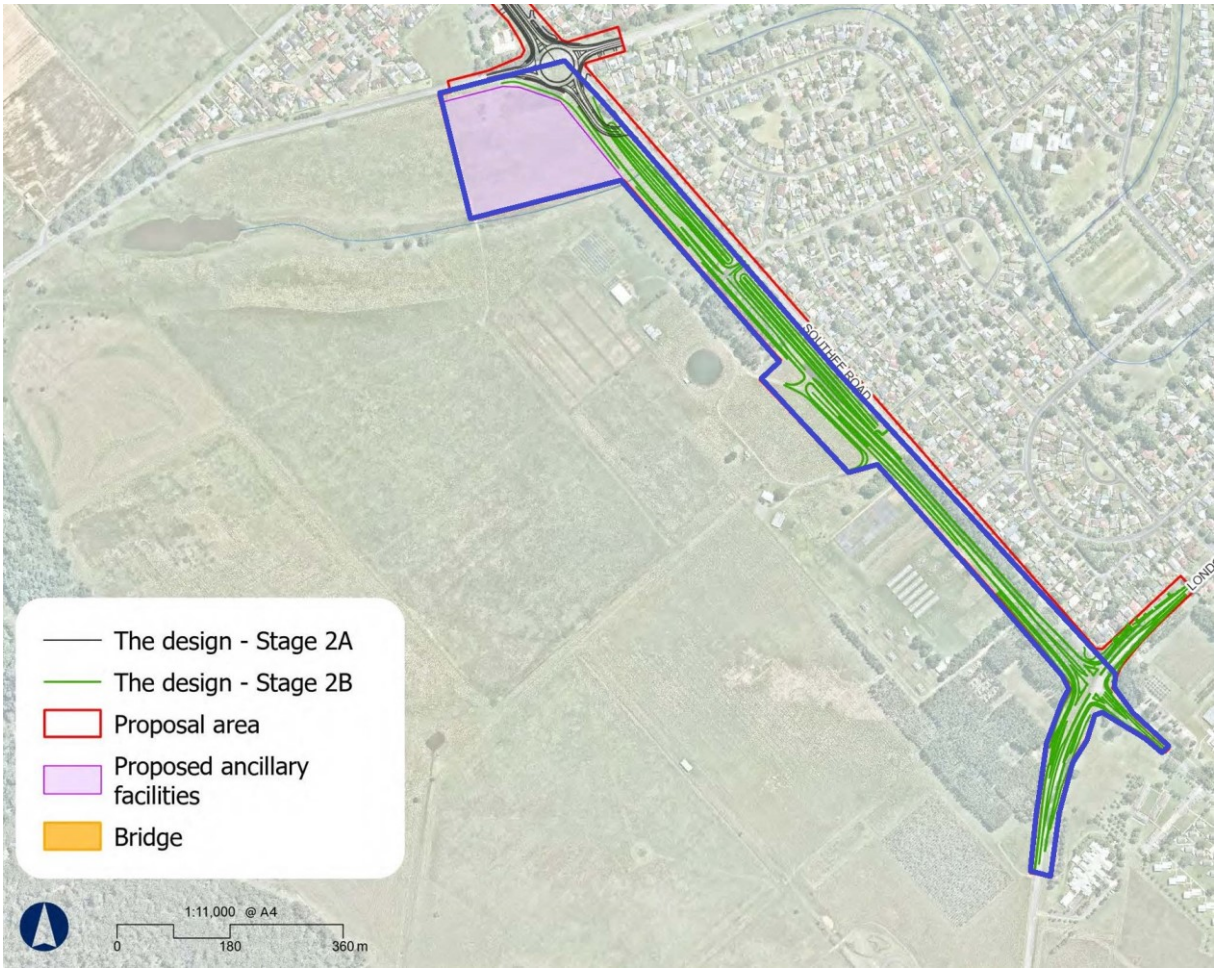

Figure 2.5: Area excluded from targeted threatened species survey (blue)

Within the areas surveyed, targeted flora survey is compliant with the BAM guidelines, TBDC and EPBC guidelines for all threatened flora species with potential to occur, except for the following species:

- ***Hibbertia puberula***: The TBDC states that survey should be undertaken when temperature is below 25°C as this drops petals at higher temperatures. Temperatures during survey were above 25°C: 33.9°C on 30th October and 30°C on 31st October recorded by the BOM for Richmond. Despite this, no *Hibbertia* or other shrub species were observed that could possibly have been *H. puberula.* Additionally, the highly disturbed and weedy condition of the site indicate that this species is not likely to occur within the proposal area.
- ***Persicaria elatior***: Survey for this species was conducted in November, which is outside of the TBDC-defined flowering period of December–May. Although outside of the defined survey period, it can be identified without flowers due to the presence of stalked glandular hairs on most parts of the plant. *Persicaria* species were observed during targeted survey but were easily identified as common species (*P. decipiens* and *P. lapathifolia*). Survey was not able to be conducted around the lagoon at 88 Inalls Lane, but given the presence of horses within that property, it is considered the *P. elatior* is unlikely to occur. No *P. elatior* were observed during survey of the potential habitat in the remainder of the proposal area and we consider that this species is absent from the proposal area.
- ***Pimelea spicata**:* The TBDC specifies survey 4 weeks after at least a 30-millimetre rainfall event, repeated at least three times, each at least a month apart unless found. This survey regime was not achievable given the time constraints of the proposal and lack of rainfall. No ≥30 millimetre rainfall events were recorded at Richmond in the four weeks leading up to survey. The highly disturbed and weedy condition of the proposal area indicate that this species is not likely to occur. Nonetheless this species should be targeted for pre-clearing surveys in all areas to ensure no undetected individuals are impacted.

Fauna survey limitations

Fauna survey was compliant with the BAM guidelines, TBDC and EPBC guidelines for all threatened species with potential to occur. Survey was not able to be conducted within Western Sydney University (WSU) nor at 88 Inalls Lane due to lack of access (Figure 2.4).

WSU land within the proposal area contains only planted native and exotic vegetation. No remnant vegetation is present and there is limited ecological value for threatened species. A constructed dam provides potential foraging habitat for Southern Myotis and it is assumed in this report to be used by this species. Low hollows within planted Pecan (*Carya illinoensis*) trees may provide roosting habitat for threatened microbats and non-threatened possums. Where any clearance of exotic hollow-bearing trees is proposed, standard pre-clearance survey is required to assess the presence of any threatened or non-threatened fauna.

Similarly, 88 Inalls lane provides low-value fauna habitat. Most vegetation is planted, with the exception of highly modified PCT 3975 Southern Lower Floodplain Freshwater Wetland, within which there is low potential for threatened frogs (as per Transport guidelines, survey for "low" potential species does not require survey – see Appendix B: Habitat suitability assessment). As with the WSU lands, the lagoon within 88 Inalls Lane is assumed to provide foraging habitat for Southern Myotis.

As with flora, fauna survey was also not conducted in the extension area mentioned above (light blue in Figure 2.4). Assumptions have been made in this BAR regarding the likely presence of threatened species in the absence of survey within this area.

3. Existing environment

Table 3.1 provides the environmental context of the study area, including the abiotic and biotic features of the landscape.

Table 3.1: Site features

Elevation	1–41 m AHD (Figure 1.1)
Topography	Undulating low hills sloping towards broad river flats either side of the Hawkesbury River (Figure 1.1).
Geology and soils	Geology: Wianamatta Group shales in north, Quaternary alluvium on river flats and floodplain (https://portal.ga.gov.au/). Soil landscapes: Blacktown in the north (shallow to moderately deep hardsetting mottled texture contrast soils, red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and in drainage lines); Freemans Reach on river flats and floodplain (Deep brown sands and loams, apedal to moderately structured, usually friable. Alluvial soils, solods and dark podzolic soils); Richmond (poorly structured orange to red clay loams, clays and sands) in the south (see https://espade.environment.nsw.gov.au/). There is a high probability of acid sulfate soil occurring in the alluvial soil where the Hawksbury River intersects the proposal area. However, in all other floodplain areas that intersect the proposal area, including the floodplain surrounding the Hawksbury River, there is a low probability of acid sulfate soil occurring (OEH, 2013).
Catchment, drainage and stream order	The northern portions of the proposal area flow into Redbank Creek and its unnamed tributary (Figure 1.1). Redbank Creek then flows into the Hawkesbury River, which also receives direct runoff from the proposal area. The southern portions of the proposal area are located on the floodplain and drain into a series of lagoons including Pughs Lagoon. These lagoons are generally self-contained except during periods of high rainfall or flooding, when they will connect with the Hawkesbury River.
Existing land use	The existing land use is a mix of public land, road reserve, reserve, and private rural, business, education and residential landholdings.

3.1 Plant community types and vegetation zones

Table 3.2 lists the PCTs identified within both the proposal area and (if applicable) the broader study area being assessed for indirect impacts. A description of the PCTs identified is provided in the following sections.

Table 3.2: Plant community types and vegetation zones

Veg. zone	Plant community type (PCT)	Threatened ecological community	Area (ha)			
			Stage 2A	Stage 2B	Proposal area	Study area
Zone 1	PCT 3320 Cumberland Shale Plains Woodland	Critically Endangered (BC Act and EPBC Act)	0.03	0.31	0.34	0.99
Zone 2	PCT 4025 Cumberland Red Gum Riverflat Forest	Endangered (BC Act); Critically Endangered (EPBC Act)	1.29	0.07	1.36	1.81
Zone 3	PCT 3975 Southern Lower Floodplain Freshwater Wetland	Endangered (BC Act)	0.54	0.01	0.55	0.89
Zone 4	Planted native vegetation	Not a TEC	1.63	2.24	3.87	6.7
		Native vegetation total	3.49	2.63	6.12	10.39
Zone 5	Exotic trees and shrubs	Not a TEC	6.79	1.71	8.5	13.48
Zone 6	Exotic grassland / pasture	Not a TEC	29.23	6.09	35.32	55.23
		Exotic vegetation total	36.02	7.8	43.82	68.71
		Grand total	39.51	10.43	49.94	79.1

3.1.1 PCT 3320 Cumberland Shale Plains Woodland

Description

This vegetation occurs in the far north-west (NW) of the proposal area, opposite and adjacent to Crooked Lane. It is dominated by *Eucalyptus tereticornis* and *E. moluccana*, the understorey is highly disturbed, with a low native species richness and a very high abundance of exotics including *Ligustrum* spp., *Lantana camara* and *Rubus fruticosus* spp. agg. This vegetation aligns with the Grassy Woodland vegetation formation.

Table 3.3: Zone 1 (PCT 3320) summary

Vegetation Zone	Zone 1
PCT ID	3320
PCT name	Cumberland Shale Plains Woodland
Vegetation class	Coastal Valley Grassy Woodlands
Vegetation formation	Grassy Woodlands
Estimate of per cent cleared	93.03 %
Conservation status	BC Act, Critically Endangered: Cumberland Plain Woodland in the Sydney Basin Bioregion. EPBC Act: aligned to Critically Endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest but vegetation does not meet condition criteria as the patch size is less than 0.5 hectares and native understorey species provide < 30% cover (see Section 3.9.1).
Vegetation zones (condition) and plots	Zone 1 – Plots 1 & 2

Justification for PCT selection:

Evidence used to identify the PCTs within the proposal area: the entire list of PCTs was exported from the online BioNet Vegetation Classification Tool. PCTs within the Cumberland IBRA subregion were filtered, with *Eucalyptus moluccana* and *E. tereticornis* as diagnostic upper-stratum species, and a Grassy Woodland vegetation class. This produced a shortlist of four PCTs:

- PCT 3318 Cumberland Moist Shale Woodland
- PCT 3319 Cumberland Shale Hills Woodland
- PCT 3320 Cumberland Shale Plains Woodland
- PCT 3321 Cumberland Shale-Sandstone Ironbark Forest

PCT 3318 can be excluded as the vegetation is dry and not located in a sheltered location, and lacks soft-leaved species, ferns and vines. PCT 3321 can be excluded as the vegetation does not contain Ironbarks or any sandstone-aligned species.

PCT 3319 and PCT 3320 are both potential matches and floristically very similar. The location of Zone 1, on lower hills and flats, indicates that PCT 3320 is the best match for this Zone.

Table 3.4: Floristic and structural summary of PCT 3320 within the study area

Growth form	Typical species
Trees	*E. tereticornis, E. moluccana, Angophora floribunda, E. eugenioides,* planted *E. saligna.*
Shrubs	Very sparse, occasional *Bursaria spinosa.*
Grass and grass-like	*Lomandra filiformis, Cynodon dactylon.*

Growth form	Typical species
Forb	Very sparse, *Dichondra repens*
Fern	absent
Other	*Glycine tabacina, Clematis aristata*
Exotic	*Toxicodendron succedaneum, Sporobolus africanus, Rostraria cristata, Sida rhombifolia, Solanum nigrum, Taraxacum officinale, Plantago lanceolata, Verbena bonariensis Bromus catharticus, Modiola caroliniana, Dolichandra unguis-cati, Solanum mauritianum, Senna pendula* var. *glabrata.*
High Threat Exotic	*Chloris gayana, Axonopus fissifolius, Passiflora suberosa, Ehrharta erecta, Ligustrum sinense, Araujia sericifera, Eragrostis curvula, Ligustrum lucidum, Lantana camara, Ochna serrulata, Olea europaea, Tradescantia fluminensis.*

Condition states

This vegetation is considered to be all one condition state, which is low-moderate

Photo 3.1: Plot 2 showing dense exotic understorey within vegetation zone 1 (PCT 3320 Cumberland Shale Plains Woodland)

Photo 3.2: Zone 1 vegetation in the location of Plot 2 from across Bells Line of Road (PCT 3320 Cumberland Shale Plains Woodland)

3.1.2 PCT 4025 Cumberland Red Gum Riverflat Forest

Description

This vegetation is restricted to the banks of the Hawkesbury River growing in alluvial sand. It is dominated by *Casuarina cunninghamiana*, with *Eucalyptus saligna* also present. The understorey is highly disturbed, with a low native species richness and a very high abundance of exotics that include *Cardiospermum grandiflorum, Ligustrum* spp., *Acer negundo* and *Tradescantia flumensis.* On the southern bank the ground and shrub layer is smothered in exotic *Cardiospermum grandiflorum*. The northern bank is more managed and is comprised of canopy trees over mown lawn, except on the steep river bank where it is weedy.

This vegetation appears to have undergone high disturbance (i.e. flooding) and clearing events and is likely to be a mix of remnant vegetation, regrowth and planted individuals. There is a lack of native species richness which makes determination of the original vegetation difficult. The presence of *E. saligna* on the southern river bank is not typical for this locality and these may have been planted.

The dominance of *C. cunninghamiana* and location on lowlands and riversides suggest that this vegetation falls within the Forested Wetland vegetation formation.

Table 3.5: Zone 2 (PCT 4025) summary

Vegetation Zone	Zone 2
PCT ID	4025
PCT name	Cumberland Red Gum Riverflat Forest
Vegetation class	Coastal Floodplain Wetlands
Vegetation formation	Forested Wetlands
Estimate of per cent cleared	88.84 %
Conservation status	BC Act, Endangered: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EPBC Act: aligned to Critically Endangered River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria, but vegetation does not meet condition thresholds as the native understorey provides < 30% cover (see Section 3.9.1).
Vegetation zones (condition) and plots	Zone 2 – Plot 9

Justification for PCT selection:

An appropriate PCT for this vegetation was not obvious. There is no PCT under the new Eastern NSW classification in the Cumberland IBRA subregion that displays a dominance of *Casuarina cunninghamiana.* Under the previous PCT classification, *PCT 1106 - River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion* would have been the best choice but as this PCT is now decommissioned an alternative must be chosen.

The SVTM maps this area of vegetation as PCT 4025 Cumberland Red Gum Riverflat Forest, and this PCT is shown as extending along most of the Hawkesbury River upstream and downstream. PCT 3145 Cumberland Bangalay x Blue Gum Riverflat Forest is mapped by the SVTM upstream. To assign the best fit PCT for Zone 2, the entire list of PCTs was exported from the online BioNet Vegetation Classification Tool. PCTs of the Forested Wetland formation within the Cumberland IBRA subregion were filtered, with *C. cunninghamiana* as a diagnostic upper-stratum species. This produced a shortlist of four PCTs:

- PCT 4023 Coastal Valleys Swamp Oak Riparian Forest
- PCT 4025 Cumberland Red Gum Riverflat Forest
- PCT 4058 Sydney Hinterland Red Gum Riverflat Forest
- PCT 4086 Sydney Coastal Sandstone Riparian Scrub

PCT 4023 can be excluded as Zone 2 is dominated by *C. cunninghamiana* (River oak) rather than *C. glauca* (Swamp Oak). This PCT is also not known to occur in the Hawkesbury LGA.

PCT 4086 can be excluded as the vegetation within Zone 2 is not coastal scrub on sandstone.

The remaining PCTs, 4023 and 4025, are floristically very similar and neither closely matches the vegetation observed. The high disturbance history and lack of native species richness makes PCT classification based on floristics difficult, and landscape position, geological and edaphic features are more informative. PCT 4023 occurs in catchments with quartz and clay-rich substrates, on alluvial flats alongside streams of the Sydney and Central Coast hinterland where the floodplain narrows in valleys with sandstone escarpments upslope. This does not match the features of Zone 2. PCT 4025, on the other hand, occurs on broad alluvial flats of the Hawkesbury and Nepean river systems dominated by clay-rich substrates, which is an accurate match with Zone 2. We conclude that PCT 4025 is the best fit PCT for Zone 2.

Table 3.6: Floristic and structural summary of PCT 4025 within the study area

Growth form	Typical species
Trees	*Casuarina cunninghamiana, E. saligna.* Exotic *Salix* spp. (Willows) and *Acer negundo* are abundant close to the river's edge.

Growth form	Typical species
Shrubs	Generally sparse, *Ficus coronata* forms dense patches in parts of the southern bank. Occasional *Glochidion ferdinandi, Melaleuca sieberi* and *Callistemon salignus.*
Grass and grass-like	Native grasses are limited to *Cynodon dactylon.* Typical exotic species are also present, such as *Bromus catharticus, Chloris gayana* and *Ehrharta erecta.*
Forb	Very sparse, *Solanum americanum*
Fern	absent
Other	Largely absent, occasional *Clematis aristata*
Exotic	*Ulmus x hollandica, Bromus catharticus, Solanum nigrum, Verbena bonariensis, Modiola caroliniana, Solanum mauritianum, Conyza bonariensis, Oxalis corniculata, Rumex crispus, Brassica nigra, Paspalum urvillei, Solanum linnaeanum, Setaria parviflora, Ammi majus, Ambrosia artemisiifolia.*
High Threat Exotic	*Tradescantia fluminensis, Cardiospermum grandiflorum, Acer negundo, Ligustrum sinense, Anredera cordifolia, Ehrharta erecta, Cestrum parqui, Acetosa sagittate, Chloris gayana, Ricinus communis, Gazania rigens.*

Condition states

This vegetation is all one condition state, which is low-moderate.

Photo 3.3: Plot 9 showing vegetation zone 2 (PCT 4025 Cumberland Red Gum Riverflat Forest)

Photo 3.4: Vegetation zone 2 on the north side of the Hawkesbury River (PCT 4025 Cumberland Red Gum Riverflat Forest)

3.1.3 PCT 3975 Southern Lower Floodplain Freshwater Wetland

Description

This vegetation occurs surrounding the lagoons and waterbodies on the floodplains south of the Hawkesbury River. It is dominated by native sedges and rushes particularly *Bolboschoenus fluviatilis,* with *Typha orientalis, Carex appressa, Phragmites australis* and *Juncus* spp. occurring in lower abundance. This zone has undergone a high level of disturbance resulting in an abundance of exotic species, particularly exotic trees and shrubs such as *Salix nigra, Ligustrum* spp. and *Ulmus x hollandica*. This vegetation only occurs where horses and other livestock have been excluded, such as within the road verge and Pugh's Reserve. Where horses are kept, particularly within the polo club grounds, the native ground layer is absent and exotic species predominate.

Table 3.7: Zone 3(PCT 3975) summary

Vegetation Zone	Zone 3
PCT ID	3975
PCT name	Southern Lower Floodplain Freshwater Wetland
Vegetation class	Coastal Freshwater Lagoons
Vegetation formation	Freshwater Wetlands
Estimate of per cent cleared	92.99 %
Conservation status	BC Act, Critically Endangered: Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. EPBC Act, not listed.

Vegetation zones (condition) and plots	Zone 4 – Plots 11 & 14

Justification for PCT selection:

Evidence used to identify the PCTs within the proposal area: the entire list of PCTs was exported from the online BioNet Vegetation Classification Tool. PCTs of the Freshwater Wetlands vegetation class within the Cumberland IBRA subregion were filtered, with *Bolboschoenus fluviatilis* and *Phragmites australis* as diagnostic grass/grass-like species. This produced a shortlist of two PCTs:

- 3962 Coastal Floodplain Phragmites Reedland
- 3975 Southern Lower Floodplain Freshwater Wetland

PCT 3962 is distinguished floristically by the strong dominance of *Phragmites australis*, which is present within Zone 3 but does not dominate except in relatively small patches. Larger areas dominated by *P. australis* do occur nearby but are outside of the proposal area. PCT 3975 is described as freshwater wetlands on low coastal floodplains and Quaternary alluvium that are not dominated by *Phragmites australis* or *Eleocharis equisetina* but instead encompasses a diverse floristic assembly – this description matches the floristic and edaphic features of Zone 3. PCT 3975 has been assigned to Zone 3.

Table 3.8: Floristic and structural summary of PCT 3975 within the study area

Growth form	Typical species
Trees	*Grevillea robusta* and *Glochidion ferdinandi*, both likely planted.
Shrubs	*Melaleuca linariifolia*, likely planted.
Grass and grass-like	*Bolboschoenus fluviatilis* (dominant), *Carex appressa, Juncus usitatus, Cynodon dactylon, Lachnagrostis filiformis, Typha orientalis, Fimbristylis dichotoma.*
Forb	*Centella asiatica, Persicaria decipiens, Alisma plantago-aquatica, Ludwigia peploides* subsp. *montevidensis, Persicaria lapathifolia, Alternanthera denticulata, Solanum americanum, Persicaria decipiens, Calotis hispidula.*
Fern	Absent.
Other	*Cassytha glabella.*
Exotic	*Aster subulatus, Conyza bonariensis, Verbena bonariensis, Toxicodendron succedaneum, Soliva sessilis, Modiola caroliniana, Oxalis corniculata, Galium aparine, Cycnogeton microtuberosum, Cerastium glomeratum, Rorippa palustris, Sida rhombifolia, Lolium perenne, Rumex crispus, Myriophyllum aquaticum, Ulmus x hollandica, Bromus catharticus, Salix nigra, Avena fatua, Ranunculus sceleratus, Cichorium endivia, Phalaris aquatica, Gamochaeta spp., Vicia sativa, Daucus carota, Cirsium vulgare, Sonchus oleraceus, Solanum mauritianum, Lysimachia arvensis.*
High Threat Exotic	*Ehrharta erecta, Cyperus eragrostis, Acetosa sagittata.*

Condition states

This vegetation is all one condition state, which is low-moderate. Areas surrounding the lagoons dominated by exotics, and where native species are absent or virtually absent, have been mapped as exotic vegetation (see Section 3.1.5).

Photo 3.5: Plot 11 showing vegetation zone 3 along edges of Pughs Lagoon (PCT 3975 Southern Lower Floodplain Freshwater Wetland)

Photo 3.6: Plot 14 showing vegetation zone 3 along edges of an unnamed lagoon (PCT 3975 Southern Lower Floodplain Freshwater Wetland)

3.1.4 Planted and native vegetation

Description

This vegetation occurs throughout the proposal area, usually in the form of native trees planted in parks, private land or roadsides, and is distinguished from remnant vegetation by obvious layout of trees indicating planting (i.e. in straight lines) and/or by species that do not occur naturally in the observed location. Common species are *Casuarina glauca* and *E. saligna*. The understorey is generally managed lawn or a mix of native and exotic species that are self-established and not part of any remnant community.

In accordance with the BAM, assessment of this vegetation does not require the application of Chapter 4 (assessing native vegetation, threatened ecological communities and vegetation integrity) and Chapter 5 (assessing the habitat suitability for threatened species for biodiversity credits). Therefore, no PCT is required to be assigned and no ecosystem or species credits are required for impacts to this planted vegetation.

This planted native vegetation has been assessed according to BAM *Appendix D.2 - Assessment of planted native vegetation for threatened species habitat*. This includes the assessment of the suitability of the planted native vegetation for use by threatened species and record any incidental sightings or evidence of threatened species credit species (flora and fauna) using or being part of the planted native vegetation.

Table 3.9: Zone 4 summary

Vegetation Zone	Zone 4
PCT ID	n/a
PCT name	n/a
Vegetation class	n/a
Vegetation formation	n/a
Estimate of per cent cleared	n/a
Conservation status	Not a TEC
Vegetation zones (condition) and plots	Zone 4 (planted) – Plots 4, 7, 15

Table 3.10: Floristic and structural summary of Zone 4 within the study area

Growth form	Typical species
Trees	*Casuarina glauca, Eucalyptus saligna, Corymbia maculata, Grevillea robusta, Eucalyptus tereticornis, Acacia parramattensis, Angophora floribunda, Melia azedarach, Eucalyptus moluccana, Casuarina cunninghamiana subsp. cunninghamiana, Glochidion ferdinandi* and *Acacia parramattensis.*
Shrubs	*Syzygium oleosum, Melaleuca sieberi, Acacia fimbriata, Ficus coronata, Callistemon salignus, Acacia implexa* and *Melaleuca linariifolia.*
Grass and grass-like	*Cynodon dactylon, Panicum spp., Juncus usitatus, Lomandra filiformis, Austrostipa setacea, Bolboschoenus fluviatilis, Lachnagrostis filiformis, Carex appressa, Panicum simile, Typha orientalis* and *Fimbristylis dichotoma.*
Forb	*Alternanthera denticulata, Rumex brownii, Calotis hispidula, Dichondra repens, Oxalis perennans, Wahlenbergia gracilis, Hypericum gramineum, Centella asiatica, Solanum americanum, Persicaria decipiens, Alisma plantago-aquatica, Ludwigia peploides subsp. montevidensis, Persicaria lapathifolia* and *Calotis hispidula.*
Fern	absent
Other	*Convolvulus erubescens, Glycine tabacina, Clematis aristata* and *Cassytha glabella.*

Growth form	Typical species
Exotic	*Cirsium vulgare, Bromus catharticus, Cenchrus clandestinus, Verbena bonariensis, Ulmus x hollandica, Solanum mauritianum, Panicum miliaceum, Lolium perenne, Sporobolus africanus, Trifolium repens, Conyza bonariensis, Aster subulatus, Soliva sessilis, Oxalis corniculata, Gamochaeta spp., Daucus carota, Taraxacum officinale, Hypochaeris radicata, Cerastium fontanum* subsp. *fontanum, Scutellaria racemosa, Polycarpon tetraphyllum, Nothoscordum borbonicum, Populus nigra, Morus alba, Dolichandra unguis-cati* and *Syagrus romanzoffiana.*
High Threat Exotic	*Cardiospermum grandiflorum, Ehrharta erecta, Chloris gayana, Cestrum parqui, Tradescantia fluminensis, Ligustrum lucidum, Araujia sericifera, Asparagus asparagoides, Eragrostis curvula, Axonopus fissifolius, Cyperus eragrostis, Senecio madagascariensis, Acetosella vulgaris, Ligustrum sinense, Lonicera japonica, Anredera cordifolia, Passiflora suberosa, Robinia pseudoacacia, Ricinus communis.*

Condition states

This vegetation is all one condition state, which is low.

Photo 3.7: Plot 15 showing planted roadside vegetation (*Casuarina cunninghamiana*)

Photo 3.8: Planted Eucalypts within WSU land

3.1.5 Exotic trees and shrubs

Description

This vegetation occurs throughout the proposal area, and ranges from planted and managed gardens and parks, through to dense thickets of naturalised shrubs and weeds. Common planted trees include *Populus nigra* (Poplar)*, Jacaranda mimosifolia* (Jacaranda)*, Caesalpinia ferrea* (Leopard Tree)*, Ulmus* spp. (Elms) and *Carya illinoensis* (Pecan). Naturalised exotic trees and shrubs include *Ligustrum* spp. (Privet), *Lantana camara* (Lantana), *Robinia pseudoacacia* (Black Locust), *Acer negundo* (Box Elder) and *Morus alba* (Mulberry). The understorey is comprised of a mix of exotic forbs, grasses and vines. Native *Melia azedarach, Acacia parramattensis* and *A. implexa* are occasionally present at very low abundance – these are widespread pioneer species that have self-established following clearance, are derived, and do not represent remnant vegetation. Similarly, native grasses and groundcovers are present at low abundance and include pioneer species common to a variety of vegetation types such as *Juncus usitatus, Lachnagrostis filiformis* and *Oxalis perennans. Cynodon dactylon* (Common Couch) is present in lawn areas at up to 20% cover – this species is widely cultivated as a lawn grass and for pasture, and although considered native there are several introduced lineages present.

This vegetation zone has been classed as exotic vegetation in accordance with the BAM, and as such no PCT can be assigned.

Table 3.11: Zone 5 summary

PCT ID	n/a
PCT name	n/a
Vegetation class	n/a
Vegetation formation	n/a

Estimate of per cent cleared	n/a
Conservation status	Not a TEC
Vegetation zones (condition) and plots	Zone 5 (Poor) – Plots 5, 10, 12 & 13

Table 3.12: Floristic and structural summary of Zone 5 within the study area

Growth form	Typical species
Trees	Dominated by exotics such as *Populus nigra, Carya illinoensis, Jacaranda mimosifolia* and *Ulmus x hollandica.* Native *Melia azedarach* and *Acacia* spp. occur in low abundance.
Shrubs	Exotic *Ligustrum sinense, L. lucidum, Lantana camara* and *Rubus fruticosus* sp. agg.
Grass and grass-like	Dominant grasses are exotic *Eragrostis curvula, Axonopus fissifolius, Paspalum dilatatum, Bromus catharticus, Ehrharta erecta, Chloris gayana, Lolium perenne, Avena fatua, Panicum miliaceum, Cenchrus clandestinus, Poa annua, Cynodon dactylon, Juncus usitatus, Lachnagrostis filiformis, Typha orientalis, Lomandra longifolia* (planted)*, Panicum simile, Austrostipa ramosissima*
Forb	Exotic *Cirsium vulgare, Tradescantia fluminensis, Verbena bonariensis, Trifolium repens, Cichorium endivia, Hypochaeris radicata, Rumex crispus, Taraxacum officinale, Galium aparine, Modiola caroliniana, Vicia sativa, Aster subulatus, Conyza bonariensis, Gamochaeta spp., Daucus carota, Lactuca saligna, Medicago polymorpha, Stachys arvensis, Nothoscordum borbonicum* and *Lysimachia arvensis.* Natives sparse, but include the occasional *Alternanthera denticulata* and *Oxalis perennans*
Fern	absent
Other	Exotic vines are abundant, including *Cardiospermum grandiflorum* and *Araujia sericifera.*

Condition states

This vegetation is all one condition state, which is poor.

Photo 3.9: Plot 13 showing vegetation zone 5 (exotic vegetation) containing planted pecan trees

Photo 3.10: Plot 10 showing vegetation zone 5 (exotic vegetation) dominated by *Ligustrum lucidum* (large-leaved privet)

Photo 3.11: Planted poplar trees (*Populus nigra*) within vegetation zone 5 (exotic vegetation) along Old Kurrajong Rd

Photo 3.12: planted exotic trees within vegetation zone 5 (exotic vegetation) in Hannah Park

3.1.6 Exotic pasture and lawn

Description

This vegetation occurs in throughout the proposal area and is comprised almost entirely of exotic species. Dominant species include *Chloris gayana, Eragrostis curvula, Lolium perenne, Bromus catharticus* and *Axonopus fissifolius.* Native species are sparse, with *Cynodon dactylon* the most abundant, occurring at c. 5% in all plots. This vegetation zone has been classed as exotic vegetation in accordance with the BAM, and as such no PCT can be assigned.

Table 3.13: Zone 6 summary

PCT ID	n/a
PCT name	n/a
Vegetation class	n/a
Vegetation formation	n/a
Estimate of per cent cleared	n/a
Conservation status	Not a TEC
Vegetation zones (condition) and plots	Zone 6 – Plots 3, 6, 8

Table 3.14: Floristic and structural summary of Zone 6 within the study area

Growth form	Typical species
Trees	Absent except for seedling exotic *Ulmus x hollandica* and native *Melia azedarach.*
Shrubs	Absent.
Grass and grass-like	Almost exclusively exotic grasses, including *Avena fatua, Eragrostis curvula, Lolium perenne, Axonopus fissifolius, Paspalum dilatatum, Briza minor, Cenchrus clandestinus, Ehrharta erecta, Poa annua* and *Rostraria cristata.* Native *Cynodon dactylon* is present in low abundance (c. 5%).
Forb	Exotic species include *Trifolium repens, Plantago lanceolata, Cirsium vulgare, Rumex crispus, Sida rhombifolia, Hypochaeris radicata, Verbena bonariensis, Vicia sativa, Modiola caroliniana, Sonchus oleraceus, Galium aparine, Taraxacum officinale, Lysimachia arvensis, Brassica nigra, Senecio madagascariensis, Cerastium fontanum, Medicago polymorpha, Soliva sessilis, Aster subulatus, Conyza bonariensis* and *Daucus carota.* Native *Oxalis perennans, Wahlenbergia gracilis, Hypericum gramineum* and *Centella asiatica* are occasionally present at < 0.5% cover.
Fern	absent
Other	Exotic *Araujia sericifera.*

Condition states

This vegetation is all one condition state, which is poor.

Photo 3.13: Plot 6 showing vegetation zone 6 (Exotic pasture and lawn)

Photo 3.14: Plot 8 showing vegetation zone 6 (Exotic pasture and lawn)

3.2 Threatened ecological communities (NSW)

Three TECs listed under the BC Act were observed within the proposal area:

- Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered)
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Critically Endangered)

Table 3.15: Threatened ecological communities listed under the BC Act

TEC	Corresponding PCT	Final Determination definition and thresholds	Justification for classification as TEC
Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (Critically Endangered)	3320 Cumberland Shale Plains Woodland	Woodland dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*), growing on the Cumberland Plain associated with clay soils derived from Wianamatta Group geology. This TEC has no condition thresholds.	PCT 3320 is woodland dominated by *E. moluccana* and *E. tereticornis*, growing on the Cumberland Plain in clay soils derived from Wianamatta Group geology. SVTM and BioNet data aligns this PCT with the TEC. There are no condition thresholds for this TEC under the BC Act, so although the vegetation within the proposal area is in low condition, it still must be classified as the TEC.
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) (Endangered)	4025 Cumberland Red Gum Riverflat Forest	Forest growing on silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains within the North Coast, Sydney Basin and South East Corner bioregions. Typically dominated by Eucalyptus, particularly *E. tereticornis*, *E. amplifolia, Angophora floribunda* and *A. subvelutina*. A larger number of characteristic species are listed in the Final Determination, including *E. saligna* and *Casuarina cunninghamiana.* This TEC has no condition thresholds.	PCT 4025 occurs on river terraces and drainage lies within the proposal area. On the riverbank is dominated by *E. saligna* and *C. cunninghamiana,* which is not a typical composition for the TEC but both these species are listed in the final determination. Areas adjacent to Redbank Creek are much more typical contain *E. tereticornis* and *A. floribunda*. A TEC dominated by *Casuarina* has previously been mapped along the Hawkesbury River downstream of the proposal area by Biosis (2021), Swamp Oak Floodplain Forest (SOFF), but that TEC contains *C. glauca* rather than *C. cunninghamiana* and is associated with saline or brackish groundwater. Brackish water is defined as water containing a salt concentration of 0.5–30 parts per thousand (ppt). Water at Richmond does not have a high saline influence, as demonstrated by water sampling of the river upstream and downstream at Windsor and Cattai, respectively, averaging 0.13–0.14 ppt (DPE 2023). The vegetation within the proposal area therefore does not meet the definition of SOFF.

TEC	Corresponding PCT	Final Determination definition and thresholds	Justification for classification as TEC
			As PCT 4025 is associated with RFEF in the SVTM and BioNet, we have applied the conservative principle and classed this vegetation as RFEF for the purposes of the BAR.
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)(Critically Endangered)	3975 Southern Lower Floodplain Freshwater Wetland	Occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. The composition FWOCF is primarily determined by the frequency, duration and depth of waterlogging and may be influenced by the level of nutrients and salinity in the water and substrate. The community is characterised by a large assemblage of species that includes *Bolboschoenus fluviatilis, Ludwigia peploides* subsp*. montevidensis, Persicaria decipiens, Carex appressa, Persicaria lapathifolia, Phragmites australis* and *Typha orientalis*, among other native sedges and rushes. It is distinct from another TEC, Sydney Freshwater Wetlands, which occurs on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion. This TEC has no condition thresholds.	PCT 3975 occurs on the edges of lagoons on the Richmond floodplain on alluvial soils. Dominant species are *Bolboschoenus fluviatilis, Typha orientalis, Phragmites australis, Persicaria decipiens, Carex appressa, Persicaria lapathifolia* and *Juncus* spp. The vegetation within the proposal area is a match for this TEC and can be confidently classified as such. Although the condition is low-moderate, there are no condition thresholds for this TEC under the BC Act so it must be classified as the TEC. Derived wetland vegetation occurring in human-made dams, as is present within the WSU lands, does not meet the definition for this TEC.

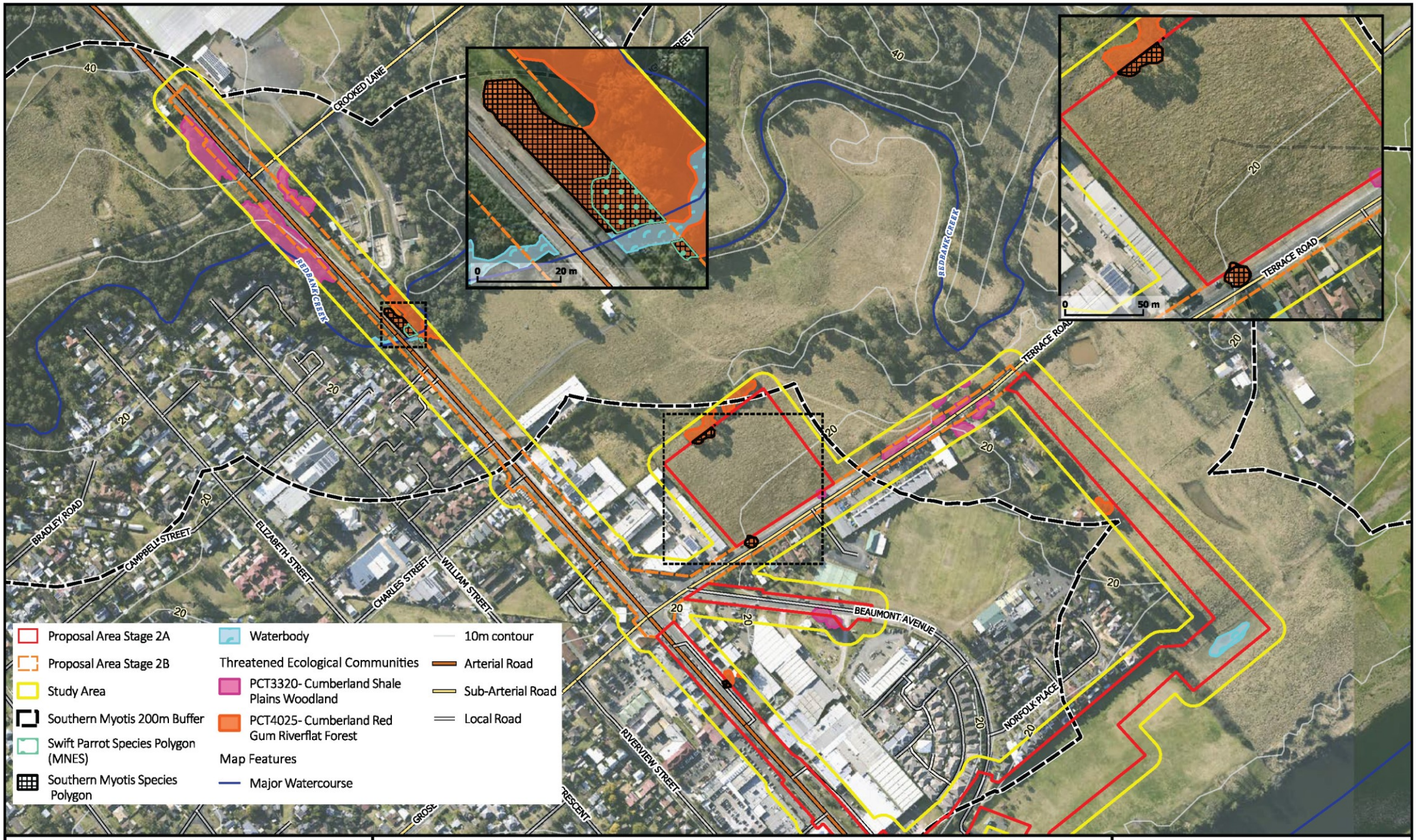

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Figure 3.1a: Threatened ecological communitites and threatened species

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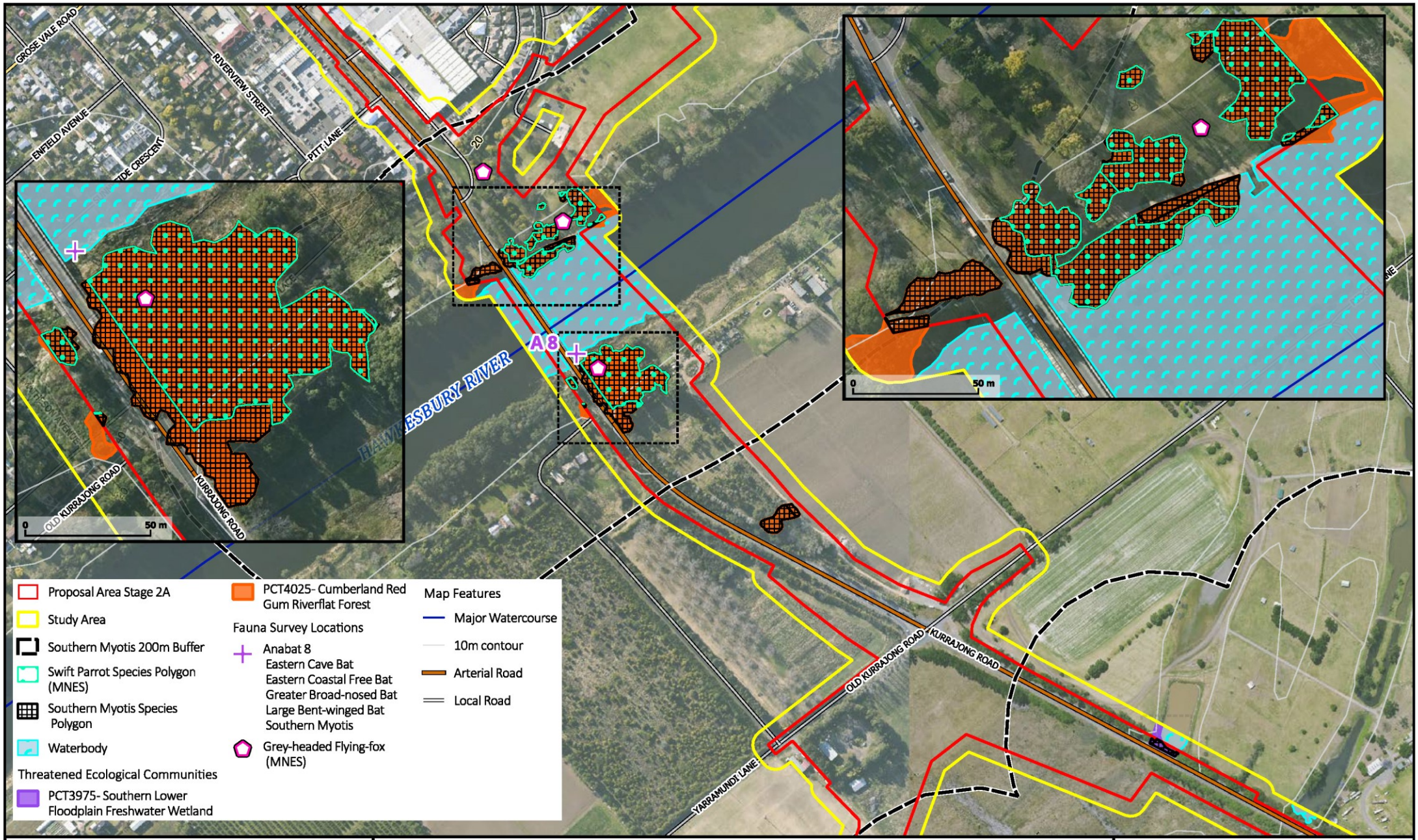

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Figure 3.1b: Threatened ecological communitites and threatened species

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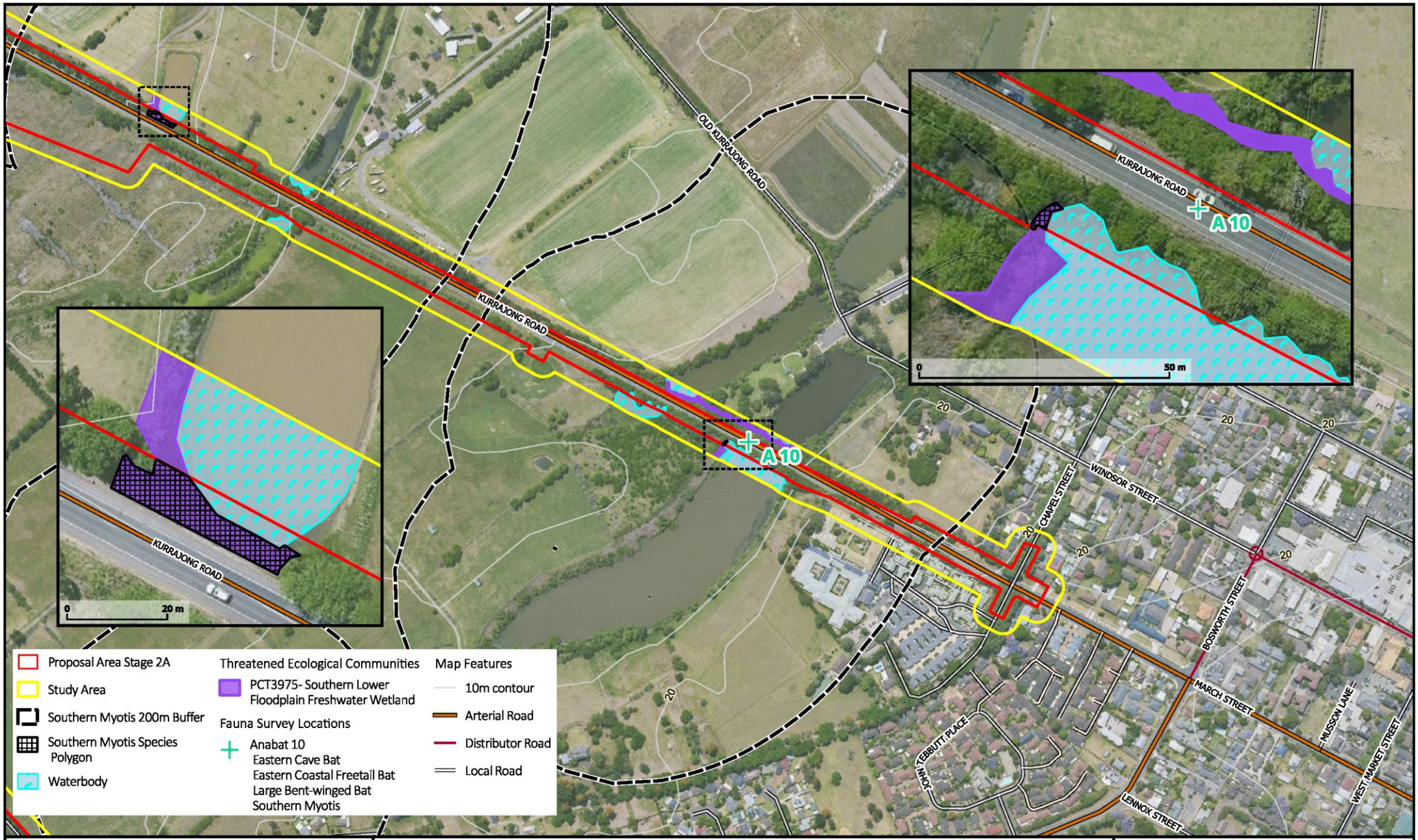

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Figure 3.1c: Threatened ecological communitites and threatened species

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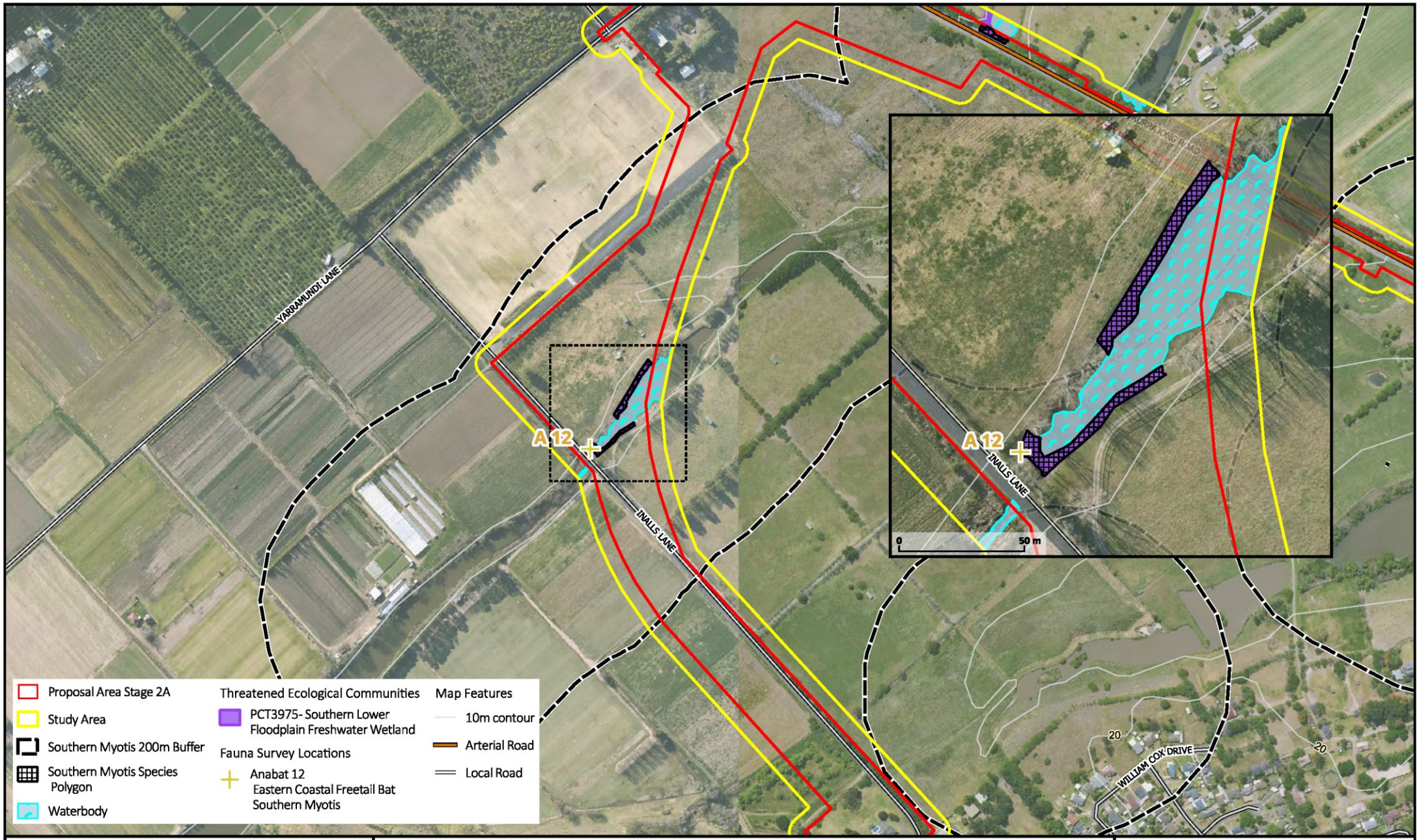

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Figure 3.1d: Threatened ecological communitites and threatened species

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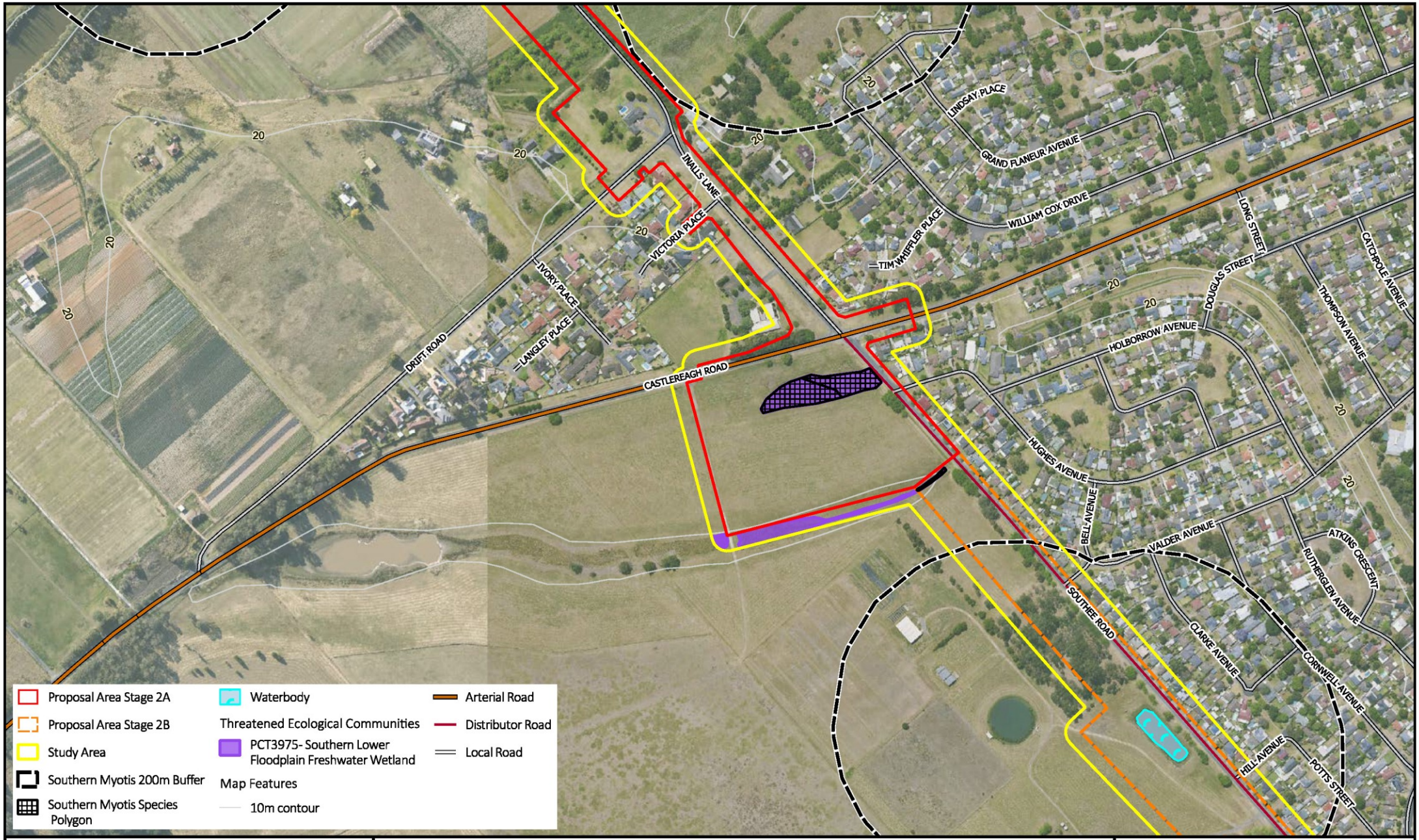

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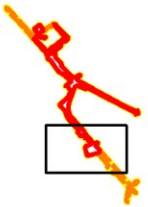

Figure 3.1e: Threatened ecological communitites and threatened species

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Figure 3.1f: Threatened ecological communitites and threatened species

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3.3 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. Some examples of ecosystems which depend on groundwater are:

- wetlands;
- red gum forests, vegetation on coastal sand dunes and other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

GDEs are therefore ecosystems which have their species composition and their natural ecological processes determined by groundwater (NSW State Groundwater Dependent Ecosystems Policy April 2002). The Groundwater Dependent Ecosystems Atlas predicts that there are high and moderate potential GDEs within and nearby the Proposal area.

PCT 3975 Southern Lower Floodplain Freshwater Wetland is a GDE that can be classed as a Wetland Ecosystem dependent on groundwater in accordance with Volume 1, Section 3 of the *Risk Assessment Guidelines for Ground Dependent Ecosystems* (Department of Primary Industries (DPI), 2012). The dependence is entire or obligate i.e. it would not exist without groundwater.

PCT 4025 Cumberland Red Gum Riverflat Forest and PCT 3320 Cumberland Shale Plains Woodland also have potential to be GDEs and may be classed as a Terrestrial Ecosystem dependent on groundwater. PCT 4025 is likely to be an obligate GDE, whereas PCT 3320 is less dependant on groundwater for survival and likely to be a facultative GDE.

Classification of these observed PCTs as GDEs was confirmed with the Groundwater Dependent Ecosystems Atlas mapping (DPE 2024) shown on Figure 3.2 of this BAR.

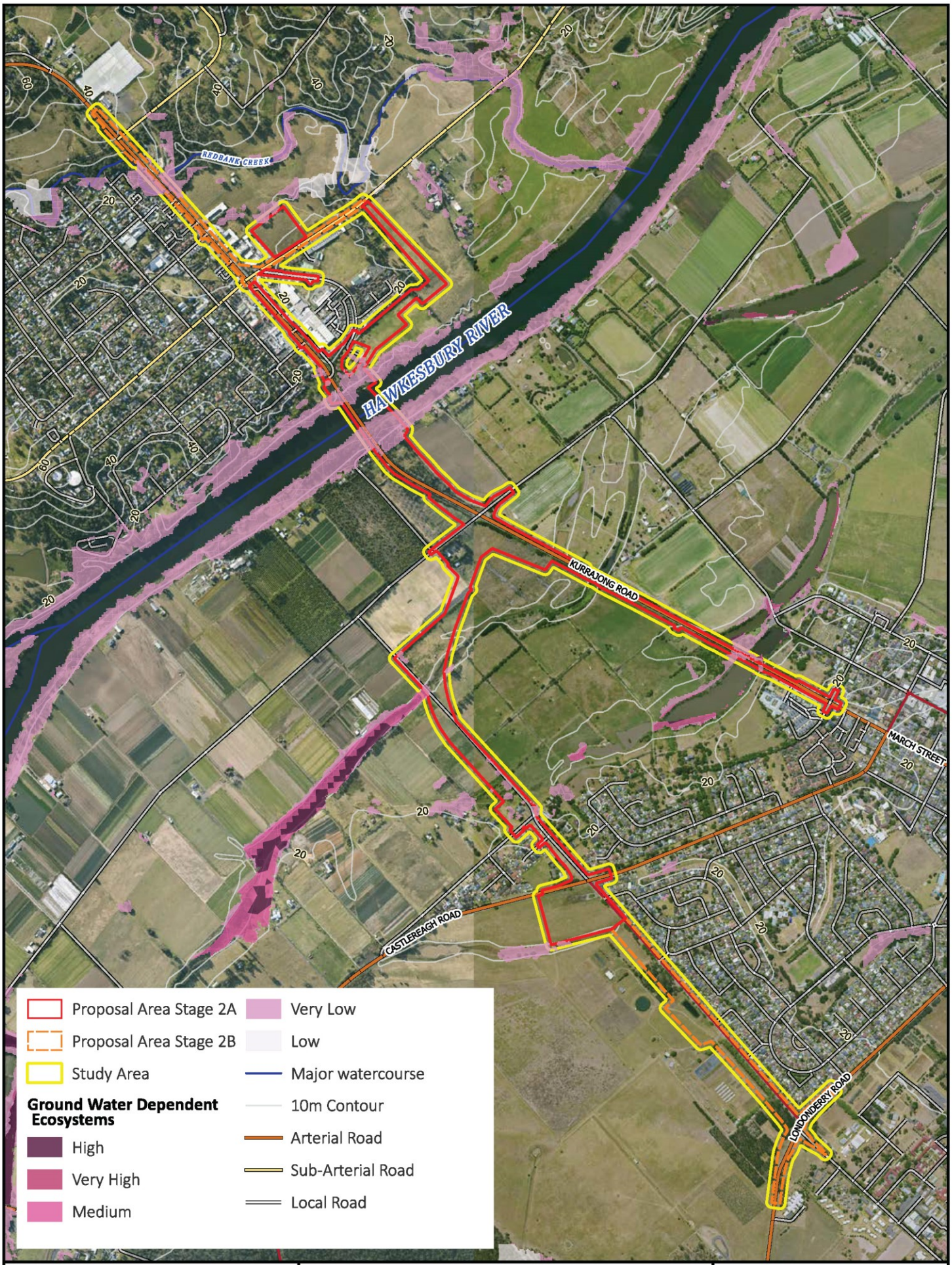

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Figure 3.2:Ground Water Dependent Ecosystems

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3.4 Threatened species (NSW)

The results of targeted surveys for species-credit species are provided in Table 3.16.

Table 3.16: Threatened species surveys results

Species name	BC Act	EPBC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?[1]	Results
Acacia pubescens **Downy Wattle**	V	V	Not recorded	Yes	Suitable habitat is restricted to PCTs 3320 and 4025, which are highly degraded. Proposal area is likely to be outside of species occurrence.
Cynanchum elegans **White-flowered Wax Plant**	E	E	Not recorded	Yes	PCTs 3320 and 4025 provide very marginal habitat. This species prefers dry rainforest. Few records within 10 km suggest the proposal area is likely to be outside of species occurrence.
Eucalyptus benthamii **Camden White Gum**	E	V	Not recorded	Yes	PCT 4025 provides marginal habitat. Few records within 10 km suggest the proposal area is likely to be outside of species occurrence.
Grevillea juniperina **subsp.** ***juniperina*** **Juniper-leaved Grevillea**	V	-	Not recorded	Yes	Suitable habitat within PCTs 3320 and 4025. It is not clear why this species is absent but there are no records within 2 km.
Haloragis exalata **subsp.** ***exalata*** **Square Raspwort**	V	V	Not recorded	Yes	PCTs 4025 and 3975 provides marginal habitat. No records within 10 km suggest the proposal area is likely to be outside of species occurrence.
Hibbertia puberula	E	-	Not recorded	See Table 2.6	Very marginal habitat, prefers dry sclerophyll on sandy soils rather than clay. No records within 10 km suggest the proposal area is outside of species occurrence.
Persicaria elatior **Tall Knotweed**	V	V	Not recorded	See Table 2.6	Marginal habitat within PCT 3975. No records within 10 km suggest the proposal area is outside of species occurrence.
Persoonia hirsuta **Hairy Geebung**	E	E	Not recorded	Yes	PCTs 4025 and 3320 provides marginal habitat. No records within 10 km suggest the proposal area is outside of species occurrence.
Pimelea spicata **Spiked Rice-flower**	E	E	Not recorded	See Table 2.6	Marginal habitat within PCT 3320 due to high disturbance and weeds. Only old nearby records (1909) indicate this species may be locally extinct.
Pterostylis saxicola	E	E	Not recorded	Yes	Marginal habitat within PCT 3320 due to high disturbance and weeds. Prefers soils

Species name	BC Act	EPBC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?[1]	Results
Sydney Plains Greenhood					with more sandstone influence. No nearby records suggest the proposal area is likely to be outside of species occurrence.
Fauna					
Lathamus discolor **Swift Parrot**	E	CE	Not recorded – mapped important habitat within proposal area	Survey not required – presence or absence assumed based on mapped important habitat	Presence assumed based on mapped important habitat.
Anthochaera phrygia **Regent Honeyeater**	E	CE	Not recorded – no mapped important habitat within proposal area	Survey not required – presence or absence assumed based on mapped important habitat	Assumed absent - no mapped important habitat within proposal area.
Lophoictinia isura **Square-tailed Kite**	V	-	Not recorded	Yes	No stick nests observed during survey. Proposal area provides foraging habitat only.
Ninox strenua **Powerful Owl**	V	-	Not recorded	Yes	No suitable hollows for breeding. Proposal area provides foraging habitat only.
Chalinolobus dwyeri **Large-eared Pied Bat**	V	V	Not recorded	Yes	Foraging and roosting habitat only – proposal area is not within 2 km of rock habitat. Recorded culverts do not provide suitable roosting or breeding habitat (see Section 3.4.1).
Miniopterus australis **Little Bent-winged Bat**	V	-	Not recorded– no potential breeding habitat.	Yes	Suitable foraging and roosting habitat. Culverts do not provide potential roosting or breeding habitat.
Miniopterus orianae oceanensis **Large Bent-winged Bat**	V	-	Species recorded – no potential breeding habitat.	Yes	Suitable foraging and roosting habitat. Culverts do not provide potential roosting or breeding habitat
Myotis macropus **Southern Myotis**	V	-	Species recorded.	Yes	Suitable foraging habitat over waterbodies. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat.
Petaurus norfolcensis **Squirrel Glider**	V	-	Not recorded	Yes	Suitable habitat within PCTs 3320 and 4025. Closest records 3 km W with narrow connective vegetation to north of the proposal area.

Species name	BC Act	EPBC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?[1]	Results
Phascolarctos cinereus **Koala**	E	E	Not recorded	Yes	Suitable habitat but landscape may be too fragmented for effective Koala dispersal.
Pteropus poliocephalus **Grey-headed Flying-fox**	V	V	Species recorded – no camps.	Yes	Recorded foraging on proposal area and flying over. Suitable foraging habitat. Close and recent records but no breeding camps within the proposal area or nearby, therefore no species polygon is required. This species is only required to be offset with ecosystem credits.
Meridolum corneovirens **Cumberland Plain Land Snail**	E	-	Not recorded	Yes	Marginal habitat within PCT 3320 and 4025. Absence likely explained by highly disturbed vegetation with high abundance of exotics. All recorded snails were identified as non-threatened native *Austrorhytida capillacea* or exotic *Bradybaena similaris.*
Pommerhelix duralensis **Dural Land Snail**	E	E	Not recorded	Yes	Marginal habitat within PCT 3320 and 4025. Absence likely explained by highly disturbed vegetation with high abundance of exotics. All recorded snails were identified as non-threatened native *Austrorhytida capillacea* or exotic *Bradybaena similaris.*

3.4.1 Threatened fauna habitat features

The following notable habitat features were observed present:

- Year-round nectar producing tree species, including winter-flowering *Eucalyptus tereticornis.*
- Seed-producing *Casuarina* trees.
- Large and small freshwater watercourses with low-quality riparian vegetation.
- Freshwater lagoons with fringing wetland vegetation.
- Dense mid and upper-storey foliage within native and exotic vegetation.
- Hollow-bearing trees providing potential roosting habitat for hollow-dependant arboreal mammals, birds and microbats.
- Human-made structures, including culverts and existing bridge over Hawkesbury River (the latter is heritage-listed and will not be impacted by the proposal)

Hollow-bearing trees were surveyed during the fauna survey with a total of 20 native and exotic trees containing hollows within the proposal area. These trees were found to contain a total of 34 hollows, including 20 small hollows (< 8 centimetres), 9 medium hollows (8–20 centimetres) and 5 large hollows (>20 centimetres). All medium hollows are < 8 metres high so do not provide suitable breeding habitat for Glossy-black Cockatoo. All large hollows were less than four metres high, and therefore not suitable for Powerful Owls.

Culverts

Three culverts were observed during survey and assessed for potential bat roost habitat. These culverts were found to be unsuitable for roosting microbats because:

- very low (< 1m high) and thus susceptible to access by predators (i.e. foxes and cats)
- their internal surface is very smooth with no seams, cracks or other features that bats depend on for roosting

- Diurnal and nocturnal survey including visual inspection and searches outside the culverts using an Anabat Walkabout did not detect any evidence of use by bats

3.4.2 Species polygons

Southern Myotis

Southern Myotis was recorded within the central and south east portions of the proposal area (Figure 3.1). Following the TBDC and BAM bat guidelines, the Southern Myotis species polygon was mapped to include all of PCTs 4025 and 3975 within the proposal area and 200 metres from a waterbody wider than 3 metres (Figure 3.1). This includes areas to the northwest of the proposal area near Redbank Creek, which must be assumed to form part of the species polygon for Southern Myotis. As ecosystem credits are required for PCT 3320, this PCT does not need to be included in the species polygon to calculate Southern Myotis offsets in accordance with Transport (2023a) No net loss guidelines.

Swift Parrot

Following the TBDC, the Swift Parrot species polygon was mapped to include all PCT 4025 intersecting the mapped Important Habitat within the proposal area (Figure 3.1). As ecosystem credits are required for PCT 3320, this PCT does not need to be included in the species polygon to calculate Swift Parrot offsets in accordance with Transport (2023a) No net loss guidelines.

3.5 Aquatic results

No aquatic surveys were conducted as part of this assessment due to the lack of potential habitat for threatened aquatic species. Assessment of impacts on Key Fish Habitat was conducted based on desktop review or existing information and habitat assessment.

As outlined in Section 2.4.4, aquatic habitat within waterways and wetlands within the study area have been assessed in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), whereby assessment sites have been classified into KEY FISH HABITAT "Type" (DPI, 2013) and waterway "Class" (Fairfull and Witheridge et al., 2003). Outcomes of this assessment are detailed in Table 3.17.

The DPI maps the Hawkesbury River and Redbank Creek as Key Fish Habitat (Figure 3.3), which our desktop assessment concurs with (Section 2.4.4). Impacts to Key Fish Habitat have been assessed in Section 5.1.4.

The proposal will cross the Hawkesbury River and Redbank Creek, along with lagoons and drains/drainage channels that connect to the Hawkesbury River. All waterway crossings have been designed with consideration of NSW Fisheries guidelines – *Why do Fish need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003) to ensure minimum impact to aquatic habitats protected under the FM Act.

Table 3.17: Fish habitat classification

Waterway / waterbody	Strahler stream order (Strahler, 1952)	Mapped as KFH (DPI, 2007)	Threatened aquatic species predicted to occur (DPI, 2016)	KFH type and sensitivity (DPI, 2013)	Waterway class (Fairfull and Witheridge, 2003)	Key features and considerations
Hawkesbury River	>6th order	Yes	No	Type 1 – Highly sensitive	Class 1 – Major fish habitat	• Major waterway within study area; forming major estuary downstream • Riparian and in-stream vegetation • Gravel beds • Large snags • Old, partially submerged, bridge piles

Waterway / waterbody	Strahler stream order (Strahler, 1952)	Mapped as KFH (DPI, 2007)	Threatened aquatic species predicted to occur (DPI, 2016)	KFH type and sensitivity (DPI, 2013)	Waterway class (Fairfull and Witheridge, 2003)	Key features and considerations
Redbank Creek	4th Order	Yes	No	Type 1 – Highly sensitive	Class 2 – Moderate fish habitat	• Tributary to Hawkesbury River • Riparian and in-stream vegetation • Few, small snags • Substrate mostly silt with minimal gravel
Pughs Lagoon, tributaries and associated lagoons; tributary lagoons to Mareh-Mareh lagoon	1st order	No	No	Type 1 – Highly sensitive	Class 3 – Minimal fish habitat	• Connects to Hawkesbury River during major flood events • Riparian and in-stream vegetation in places; highly managed in others with little or no vegetation (i.e. horse paddocks) or exotic vegetation • Some areas mapped as Coastal Wetland and Proximity Areas to Coastal Wetlands (Resilience and Hazards SEPP)

0 0.1 0.2 0.3 0.4 0.5 km

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Figure 3.3: Key Fish Habitat

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3.6 Areas of outstanding biodiversity value

No areas of outstanding biodiversity value occur within the study area.

3.7 Wildlife connectivity corridors

No mapped wildlife or habitat corridors relevant to the proposal are known to be mapped within the proposal area or nearby.

Remnant PCT 3320 vegetation in the northern portion of the proposal area opposite Crooked Lane is well connected with substantial and similar vegetation upstream via Redbank Creek riparian vegetation. This connectivity is partially fragmented by minor roads and residential development before reaching the greater Blue Mountains wilderness.

Minor connectivity is also present along the northern bank of the Hawkesbury River, extending about two kilometres upstream.

Connectivity across the remainder of the proposal area is broken by the Hawkesbury River, large roads, agricultural land and urban development.

Figure 1.1 shows general connectivity features across the assessment area.

3.8 SEPPs

3.8.1 Resilience and Hazards SEPP 2022.

Areas including and surrounding several of the lagoons within the study area are mapped as Coastal Wetlands (Figure 1.1). As stated in the *State Environmental Planning Policy (Resilience and Hazards) 2022*, development consent is required for any development within these areas and must not be given unless the consent authority is satisfied that sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland.

The proposal has been designed to avoid direct impacts to the mapped Coastal Wetland areas and as such development consent under the SEPP is not required. The proposal area is not located within any mapped Coastal Wetland areas (Figure 1.3). Indirect impacts to the mapped Coastal Wetlands are considered as part of the assessment in Section 5.2. If the proposal is changed such that it will cause direct impacts to the mapped Coastal Wetlands, that portion of the proposal will be deemed designated development and would require an Environmental Impact Statement to be prepared for assessment in accordance with Clause 2.7 of the Resilience and Hazards SEPP.

Areas of the proposal area are mapped as Proximity Areas to Coastal Wetlands (Figure 1.1). As the proposal is being assessed under Division 5.1 of the EP&A Act and does not require development consent, Clause 2.8 of the SEPP does not apply. Although an assessment against the clauses pertaining to the Proximity Areas to Coastal Wetlands Division is not required, items within Clause 28 of the SEPP are considered below in Table 3.18.

Table 3.18: Proximity areas to coastal wetlands considerations

Consideration for land identified as "proximity area for coastal wetlands"	Comment
Will the proposed development significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland?	The adjacent coastal wetlands currently occur in a highly disturbed environment with modified biophysics and hydrology. Ecological integrity is also highly reduced. With implementation of appropriate mitigation measures (see Section 6) the proposal is not likely to significantly impact on these components of the adjacent coastal wetlands. Direct impacts to aquatic habitat are assessed in Section 5.1.4, while indirect impacts are assessed in Section 5.2.
Will the proposed development significantly impact on the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland?	The proposal will incorporate drainage structures to control road runoff to downstream receiving watercourses including coastal wetlands. Open channels are incorporated in the proposal to divert external catchment runoff away from the road. A mix of basins and grassed swales will be used to manage and treat

Consideration for land identified as "proximity area for coastal wetlands"	Comment
	runoff. The proposal is not likely to have a demonstrable impact on the quality or quantity of surface water flows into the coastal wetlands areas. Ground water flows are not likely to be significantly impacted given the existing altered hydrology associated with the existing road surfaces and man-made drainage features, and implementation of best-practice stormwater management and infrastructure

3.8.2 Biodiversity and Conservation SEPP 2021 – Chapter 4 Koala Habitat Protection.

State Environmental Planning Policy (Biodiversity and Conservation) 2021 – chapter 4 Koala Habitat Protection applies to land within LGAs listed under Schedule 2 of the Policy. As the study area falls within the City of Hawkesbury LGA, which is listed under Schedule 2, it is considered that Chapter 4 of the SEPP 2021 may apply to the study area if the study area contains core koala habitat.

Under the SEPP, core koala habitat is defined as:

a) *an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or*

b) *an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years*

As of November 2023, 318 Koala sightings have been recorded in BioNet within 10 kilometres of the study area. The nearest Koala record to the study area was a rehabilitation record from Richmond in 2022. Another rehabilitation record exists in North Richmond from 2014. Of the non-rehabilitation individuals, the closest records are a 2013 record from Clarendon (3.8 kilometres from the study area), a 2016 record from Freemans Reach (3 kilometres from the study area), and a 2017 record from along Redbank Rd (2.8 kilometres from the study area). Overall, the Koala population within the vicinity appears to be mostly located in the Grose Vale and Kurrajong areas.

The Department of Planning, Industry and Environment (DPIE) list seven Koala Management Areas (KMAs) which provide regional divisions across New South Wales, partly based on the distribution of preferred koala food trees and partly on local council boundaries to make management of resources easier. As the study area falls under the City of Hawkesbury, the Central Coast KMA applies regarding Koala use tree species. Eleven tree species were recorded in the study area which are Koala use tree species within this KMA: *Casuarina glauca, Eucalyptus crebra, E. eugenioides, E. pilularis, E. piperita, E. saligna, E. tereticornis, E. microcorys, E. moluccana, E. tereticornis* and *Syncarpia glomulifera*. Of these *E. microcorys* and *E. tereticornis* are considered Koala feed tree species. Both are present in low numbers within planted native vegetation, whilst remnant vegetation containing *E. tereticornis* is limited to PCTs 3320 and 4025 in the north of the study area. Areas of PCT 4025 along the river do not contain suitable feed trees for this species, being dominated by *Casuarina* and *E. saligna.*

No evidence of Koala activity was recorded during survey, which included the Spot Assessment Technique (SAT) and spotlighting in accordance with the BAM guidelines (see Section 2.4.3). Despite the prominence of Koalas within a 10-kilometre radius and the presence of Koala use tree species, the proposal area is not considered to contribute to core Koala habitat due to the lack of any evidence of Koala presence within the study area during surveys or from BioNet records over the last 18 years.

3.9 Matters of national environmental significance

3.9.1 Threatened ecological communities (Commonwealth)

Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

PCT 3320 Cumberland Shale Plains Woodland is aligned with, and potentially equivalent to, *Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest* which is listed under the EPBC Act as critically endangered. To be classified as part of this TEC, the vegetation in question must meet key diagnostic and conditional criteria as detailed in the Commonwealth Listing Advice (Threatened Species Scientific Committee 2009).

PCT 3320 (Zone 1) can be assessed against the key diagnostic criteria as follows:

1. Occurs in the Sydney Basin IBRA bioregion, and Cumberland IBRA sub-region
2. Occurs on clay soils derived from Wianamatta Group geology
3. Upper tree layer of over 10% cover, and dominated by *E. tereticornis* and *E. moluccana*
4. The understorey is not comprised primarily of diagnostic perennial native graminoids and forbs. PCT 3320 within the study area is highly modified with very few native species in the understorey. There is a high abundance within Plot 1, but this is owing to an abundance of the widely cultivated lawn species, *Cynodon dactylon*, which is not diagnostic for the TEC.

PCT 3320 vegetation must also meet the condition criteria. These have been assessed in the flow chart below (Figure 3.4) using data from plots 1 and 2.

Some of the criteria relate to native perennial understorey cover as a percentage of the total. Values for Plots 1 and 2 are shown in Table 3.19.

Table 3.19: Perennial understorey cover in PCT 3320

Understorey cover	Plot 1	Plot 2
Native	92.3	8.1
Exotic	14.0	99.6
Total	106.0	107.7
% Native	**87%**	**7.5%**

Within Plot 1, perennial native understorey is 87%, owing mostly to the large amount of *Cynodon dactylon* lawn in this managed piece of vegetation. In Plot 2 it is only 7.5%.

The questions in the flow chart can be answered as follows:

Q1 – Tree cover 10% or more? Yes – Go to Q2. Tree cover was >15% in both plots.

Q2 – Patch size 0.5 hectares or more? Plot 1: No – patch size is about 0.4 hectares and not the TEC; Plot 2: Yes – Patch size is > 10 hectares, go to Q3.

Q3 – Perennial understorey is comprised of 50% or more in native species? Plot 1: 87%, but most is *C. dactylon*; Plot 2: 7.5%

Q4 – Is the patch size 5 hectares or more? Plot 1: No – patch size is about 0.4 hectares; Plot 2: Patch size is > 10 hectares– Go to Q5.

Q5 – Perennial understorey is comprised of 30% or more in native species? Plot 1: 87%, but most is *C. dactylon*; Plot 2: 7.5%.

Based on this assessment and the data collected, vegetation within and around Plot 1 does not meet the conditional thresholds as the patch size is less than 0.5 hectares. Vegetation within and around Plot 2 is not commensurate with the TEC due to a very low abundance of native understorey species (Table 3.19). In consideration of this, we consider that PCT 3320 is not commensurate with the TEC as listed under the EPBC Act.

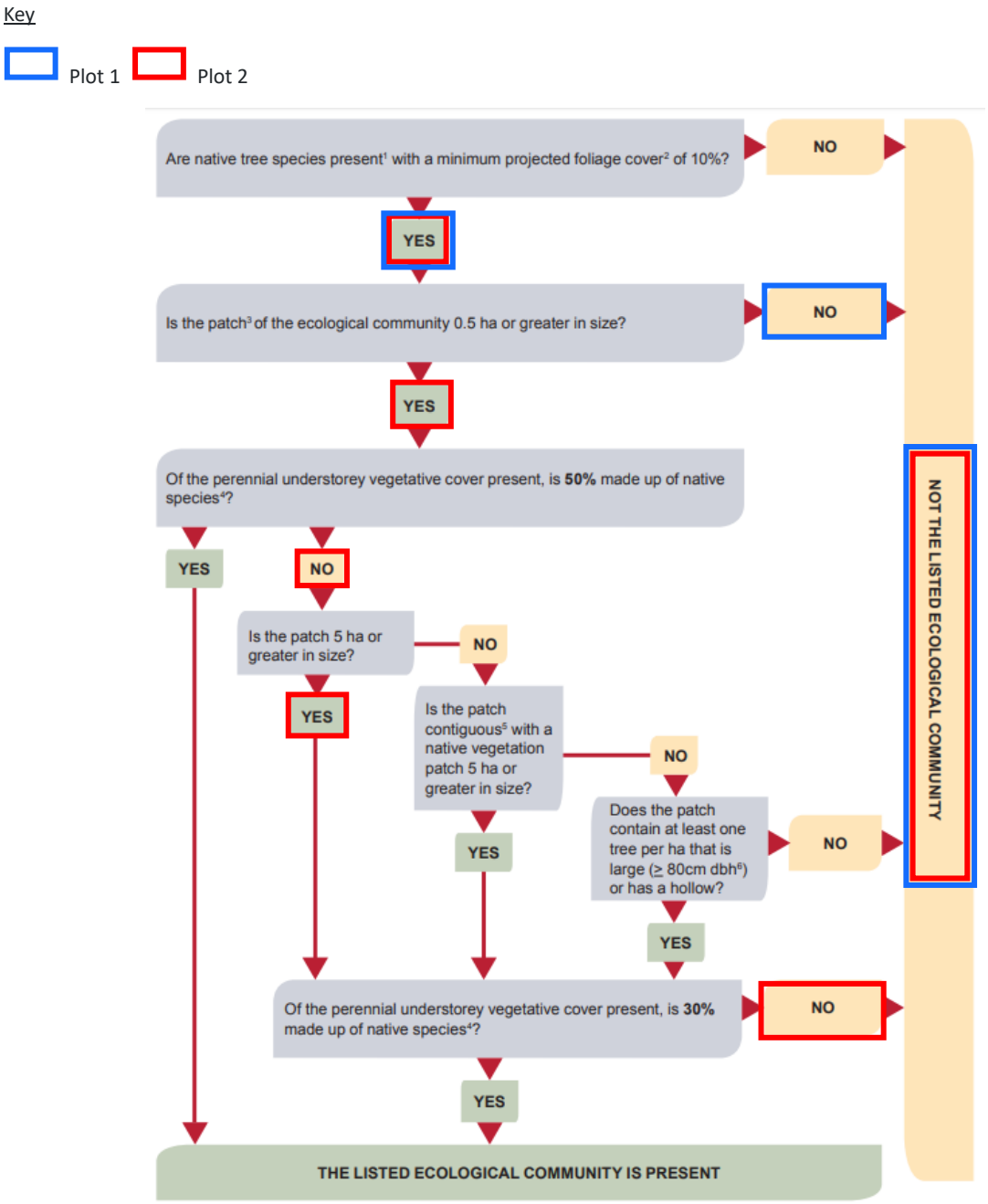

Figure 3.4: Flowchart for identifying Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

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

PCT 4025 Cumberland Red Gum Riverflat Forest is aligned with, and potentially equivalent to, *River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria* which is listed under the EPBC Act as critically endangered. To be classified as part of this TEC, the vegetation in question must meet key diagnostic and conditional criteria as detailed in the Commonwealth Conservation Advice approved Conservation Advice (DAWE 2020).

PCT 4025 (Zone 2) can be assessed against the key diagnostic criteria as follows:

- Occurs in the Sydney Basin IBRA Bioregion.
- Occurs within a catchment of the eastern watershed of the Great Dividing Range.
- Occurs at elevations up to 250 metres above sea-level (ASL), but most typically below 50 metres ASL.
- Occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, in this case floodplains, river-banks and riparian zones.

- Occurs on alluvial soil.
- Occurs as a tall closed to open forest with a canopy crown cover of >20%.
- Areas with *E. saligna*, *Angophora* floribunda and *E. tereticornis* dominant meet the diagnostic criteria. Areas dominated by *Casuarina cunninghamiana* do not meet the criteria as this species is not listed as a dominant species in the Conservation Advice.

PCT 4025 vegetation must also meet the condition criteria. These have been assessed in the flow chart below using data from Plot 9. Vegetation must be classed as C2 or higher to be considered part of the EPBC-listed TEC.

Some of the criteria relate to native perennial understorey cover as a percentage of the total. Values for Plot 9 are shown in Table 3.20. As the perennial native understorey cover of 10.2% is less that the condition threshold of 30% for the lowest condition class (C2), the vegetation within the proposal area does not meet the condition thresholds to be classified as the EBPC-listed TEC.

In conclusion, PCT 4025 is not commensurate with *River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern* as listed under the EPBC Act.

Table 3.20: Perennial understorey cover in PCT 4025

Understorey cover	Plot 9
Native	8.1
Exotic	71.5
Total	79.6
% Native	**10.2%**

Patch size thresholds → / Biotic thresholds ↓	Large patch Patch size ≥ 2 ha	Small contiguous[7] patch Patch size ≥ 0.5 ha within a larger area of native vegetation ≥ 5 ha	Small patch Patch size ≥ 0.5 ha
High condition ≥ 80% of its total perennial understorey vegetation cover[1] is comprised of native species AND Ground cover richness[2] ≥ 10 native species per sample plot AND ≥ 20 large trees[3] per ha	CLASS A1 Large or contiguous patch in high condition		CLASS B1 Small patch in high condition
Good condition with arboreal mammals ≥ 50% of its total perennial understorey vegetation cover[1] is comprised of native species AND Ground cover richness[2] ≥ 6 native species per sample plot AND At least 10 large trees[3] per ha AND Evidence of 4 or more species of arboreal mammals[4] detected[5] in the patch	CLASS A2 Large or contiguous patch in good condition with arboreal mammals		CLASS B2 Small patch in good condition with arboreal mammals
Good condition ≥ 50% of its total perennial understorey vegetation cover[1] is comprised of native species AND Ground cover richness[2] ≥ 6 native species per sample plot AND At least 10 large trees[3] per ha	CLASS B3 Large or contiguous patch in good condition		CLASS C1 Small patch in good condition
Moderate condition ≥ 30% of its total perennial understorey vegetation cover[1] is comprised of native species AND Ground cover richness ≥ 4 native species per sample plot[2]	CLASS C2 Large or contiguous patch in moderate condition		

[1] Perennial understorey vegetation cover includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil.

[2] Ground cover richness includes combined species richness of native grasses, forbs, ferns and sedges per 0.04 ha (20 x 20 m sample plot).

[3] Large eucalypt trees are greater than 45 cm [diameter at breast height (dbh)]. This is used as a surrogate for tree hollows and habitat values.

[4] Excluding micro-bats (Microchiroptera).

[5] Survey guidelines (DSEWPC 2011).

[7] Contiguous means the patch is connected to, or in close proximity to (i.e. within 30 m of), another area of native vegetation (i.e. an area where the total perennial vegetation cover is dominated (50 percent or more) by native plant species).

Figure 3.5: Flowchart for identifying River-flat eucalypt forest on coastal floodplains

3.9.2 Threatened flora species (Commonwealth)

Habitat suitability assessment has been conducted for threatened flora listed under the EPBC Act in Appendix B: Habitat suitability assessment.

Based on this, it is considered that the proposal area provides low potential habitat for the following nationally listed threatened flora species:

Table 3.21: Nationally listed threatened flora species with suitable habitat present

Scientific name	*EPBC Act*	Potential to occur
Pimelea spicata	E	low
Acacia pubescens	V	low
Cynanchum elegans	E	low
Eucalyptus benthamii	E	low
Haloragis exalata subsp. *exalata*	V	low
Persicaria elatior	V	low
Persoonia hirsuta	E	low
Pterostylis saxicola	E	low

Targeted survey has been conducted for the species listed above as detailed in Section 2.4.2. None of these species have been observed within the proposal area or study area and these is low likelihood of occurrence within areas not surveyed. No Assessment of Significance under the EPBC Act is required.

3.9.3 Threatened fauna species (Commonwealth)

EPBC Act – A search of the *BioNet* (DPIE, 2023) and the EPBC Search Tool provided a list of nationally threatened fauna species previously recorded, or with considered potential habitat, within a 10-kilometre radius of the proposal area. These species have been listed and considered for habitat potential based on proximity and year of records in Appendix B: Habitat suitability assessment. In accordance with the Transport assessment guidelines, only fauna species with moderate or higher potential to occur require further assessment.

Based on this, it is considered that the proposal area provides varying levels of potential habitat for the following nationally listed threatened fauna species (Table 3.22):

Table 3.22: Nationally listed threatened fauna species with suitable habitat present

Common name	EPBC Act	Potential to occur
Grey-headed Flying-fox	V	Recorded foraging / fly over - no camps
Swift Parrot	CE	High
Regent Honeyeater	CE	Moderate
Large-eared Pied Bat	V	Moderate

One nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded within the proposal area during surveys undertaken. This species was observed foraging and flying over the study area. No camps were observed.

Significant Impact Criteria for a species listed under the EPBC Act 1999 was reviewed to assess the proposed impacts on species with moderate to high likelihood of occurrence within the study area (species in Table 3.22). These assessments are provided in Appendix E: Assessments of significance (EPBC Act).

3.9.4 Protected migratory species (Commonwealth)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10-kilometre radius of the proposal area. The habitat potential of migratory species are considered in Appendix B: Habitat suitability assessment.

The proposal area does contain permanent waterbodies that may provide foraging and potential marginal breeding habitat for migratory bird species. However, due to the small area (< 0.55 ha) of waterbodies being directly impacted and well represented similar habitat remaining in the locality, there will not be any significant impact on any nationally protected migratory bird species with potential to occur, from the proposal.

4. Avoidance and minimisation

This chapter outlines the steps that have been taken to avoid and minimise impacts to biodiversity. 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'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.
2. Mitigate impacts.
3. Offset impacts in accordance with Transport guidelines.

The following strategies and actions have been undertaken to either avoid or minimise impacts on biodiversity values:

- Impacts from clearing native vegetation and threatened species habitat has been minimised by locating the proposal to utilise:
    - existing road corridors
    - cleared areas
    - low-condition, planted and exotic vegetation
    - areas with no mapped Biodiversity Values
- Minimisation of impacts to recorded TECs Cumberland Plain Woodland, River-flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains
- Avoidance of direct impacts to mapped Coastal Wetlands
- Minimised impact to the Proximity Area to Coastal Wetlands
- Locating ancillary facilities in areas where there are no or low biodiversity values (e.g. utilising Hanna Park for temporary access during construction).

5. Impact assessment

The proposal's likely direct and indirect impacts on biodiversity are summarised in this chapter. Direct impacts for the BAR have been calculated within the proposal area using the construction and operational footprints of the REF as the extent of impact. The potential for indirect impacts on biodiversity values is considered low given that much of the REF area is subject to existing edge effects, and surrounded by existing roads, agricultural land and development.

5.1 Construction direct impacts

5.1.1 Removal of native vegetation

Key assumptions of the construction assessment for the proposal include:

- All vegetation within the proposal area will be cleared, with the exception of areas of PCT 4025 in the vicinity of Redbank Creek (Figure 2.2)
- An exclusion zone within the proposal area at the boundary of areas identified as Coastal Wetlands under the Resilience and Hazards SEPP will be established to avoid direct impact to vegetation within the Coastal Wetland areas. This exclusion area will not include the Coastal Wetlands Proximity areas that are located within the proposal area.
- Areas of PCT 3975 – Southern Lower Floodplain Freshwater Wetland within the Proposal area are not mapped as Coastal Wetland areas, therefore do not require exclusion zones, and are part of the areas that are assumed to be cleared as part of this proposal.

The direct impacts of the proposal on native vegetation are identified in Table 5.1. Impacts are based on ground-truthed vegetation boundaries, except in the area excluded from survey identified in Figure 2.4 where vegetation is mapped based on desktop assessment. Most of the vegetation to be cleared is exotic vegetation, totalling 43.82 hectares, while 6.12 hectares of native vegetation is to be cleared.

Table 5.1: Summary of direct impacts on native and exotic vegetation

Veg. zone	Plant community type (PCT) / vegetation community	Broad condition class	TEC	Area to be impacted (ha)		
				Stage 2A	Stage 2B	Total
Zone 1	3320 Cumberland Shale Plains Woodland	Low-moderate	Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (Critically Endangered)	0.03	0.31	0.34
Zone 2	4025 Cumberland Red Gum Riverflat Forest	Low-moderate	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) (Endangered)	1.29	0.07	1.36
Zone 3	3975 Southern Lower Floodplain Freshwater Wetland	Low-moderate	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)(Endangered)	0.54	0.01	0.55
Zone 4	Planted native vegetation	Low	Not a TEC	1.63	2.24	3.87
			Native vegetation total	3.49	2.63	6.12
Zone 5	Exotic trees and shrubs	Low	Not a TEC	6.79	1.71	8.5

Veg. zone	Plant community type (PCT) / vegetation community	Broad condition class	TEC	Area to be impacted (ha)		
				Stage 2A	Stage 2B	Total
Zone 6	Exotic grassland / pasture	Low	Not a TEC	29.23	6.09	35.32
			Exotic vegetation total	36.02	7.8	43.82
			Grand total	39.51	10.43	49.94

5.1.2 Removal of threatened fauna habitat

The extent of native vegetation clearing estimated to result from the proposal is detailed above in Section 5.1.1. This vegetation, including planted native vegetation (PNV) and planted exotic vegetation, provides suitable habitat for several threatened fauna species listed under the BC Act and EPBC Act. As such, direct impacts through loss of potential and known habitat for threatened fauna species (although of moderate to low quality) will occur during construction (Table 5.2).

Table 5.2: Summary of direct impacts on threatened fauna and habitat

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
Anthochaera phrygia **Regent Honeyeater**	E	CE	Ecosystem only (no mapped habitat)	Moderate	Suitable foraging habitat within PCT 3320 and 4025, and PNV.	2.95	2.62	5.57
Artamus cyanopterus cyanopterus **Dusky Woodswallow**	V	-	Ecosystem	Moderate	Suitable foraging habitat within PCT 3320 and 4025, and PNV.	2.95	2.62	5.57
Daphoenositta chrysoptera **Varied Sittella**	V	-	Ecosystem	Moderate	Suitable foraging habitat within PCT 3320, 4025 and PNV.	2.95	2.62	5.57
Glossopsitta pusilla **Little Lorikeet**	V	-	Ecosystem	Moderate	Suitable foraging and breeding habitat provided by remnant and planted Eucalypts within PCT 3320, 4025 and PNV.	2.95	2.62	5.57

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
Lathamus discolor **Swift Parrot**	E	CE	Ecosystem and species	High	Suitable winter foraging habitat within PCT 3320, 4025 and PNV (may feed on lerps on Eucalypts, particularly *E. tereticornis* and *E. moluccana*). Mapped important habitat within proposal area.	2.95 ha total foraging; 0.91 ha mapped important habitat.	2.62 ha total foraging; 0.02 ha mapped important habitat	5.57 ha total foraging; 0.93 ha mapped important habitat.
Lophoictinia isura **Square-tailed Kite**	V	-	Ecosystem only (no breeding habitat)	Moderate	No stick nests observed during survey. Proposal area provides foraging habitat only, within all vegetation except pasture.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha potential foraging habitat
Ninox strenua **Powerful Owl**	V	-	Ecosystem only (no breeding habitat)	Moderate	No suitable hollows for breeding. Proposal area provides foraging habitat only, within all vegetation except pasture.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha potential foraging habitat
Oxyura australis **Blue-billed Duck**	V	-	Ecosystem	Moderate	Suitable foraging habitat within PCT 3975. Breeding habitat	0.54 ha foraging and marginal breeding habitat.	0.01 ha foraging and marginal breeding habitat.	0.55 ha foraging and marginal breeding habitat.

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
					marginal due to lack of large areas of Cumbudgi or deep water.			
Stictonetta naevosa **Freckled Duck**	V	-	Ecosystem	Moderate	Suitable foraging habitat within PCT 3975. Breeding habitat marginal due to lack of large areas of Cumbudgi or deep water.	0.54 ha foraging and marginal breeding habitat.	0.01 ha foraging and marginal breeding habitat.	0.55 ha foraging and marginal breeding habitat.
Chalinolobus dwyeri **Large-eared Pied Bat**	V	V	Species	Moderate	Foraging and roosting habitat only within all vegetation except pasture. Recorded culverts do not provide suitable roosting or breeding habitat.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha potential foraging habitat
Falsistrellus tasmaniensis **Eastern False Pipistrelle**	V	-	Ecosystem	Recorded	Suitable foraging, roosting and breeding habitat within all vegetation except pasture.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha foraging habitat. Removal of up to 34 tree hollows providing potential roosting and breeding habitat.
Micronomus norfolkensis **Eastern Coastal Free-tailed Bat**	V	-	Ecosystem	Recorded	Recorded within proposal area during survey.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha foraging habitat. Removal of up to

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
					Proposal area provides suitable foraging, roosting and breeding habitat within all vegetation except pasture. Culverts do not provide potential roosting or breeding habitat.			34 tree hollows providing potential roosting and breeding habitat.
Miniopterus australis **Little Bent-winged Bat**	V	-	Species (breeding habitat absent)	Moderate	Suitable foraging and roosting habitat within all vegetation except pasture. Culverts do not provide potential roosting or breeding habitat.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha foraging habitat. Removal of up to 34 tree hollows providing potential roosting habitat. No species credits required
Miniopterus orianae oceanensis **Large Bent-winged Bat**	V	-	Species (breeding habitat absent)	Species recorded – no breeding presence	Suitable foraging and roosting habitat within all vegetation except pasture. Culverts do not provide potential roosting or breeding habitat	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha foraging habitat. Removal of up to 34 tree hollows providing potential roosting habitat. No species credits required
Myotis macropus **Southern Myotis**	V	-	Species	Recorded	Suitable foraging habitat over waterbodies . Species polygon	Water surface area for foraging not likely to be	0.07 ha of species polygon habitat impacted (includes	1.91 ha of species polygon habitat impacted (includes

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
					includes associated PCTs with 200m of waterbodies. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat.	significantly impacted. Pylons within river and lagoons are easily avoided by Southern Myotis. 1.83 ha of species polygon habitat impacted (includes PCTs 4025 & 3975).	PCTs 4025 & 3975).	PCTs 4025 & 3975).
Petaurus norfolcensis **Squirrel Glider**	V	-	Species	Low	Suitable foraging habitat within PCTs 3320 and 4025, and PNV although targeted survey did not detect species.	No impact	No impact	No impact
Phascolarctos cinereus **Koala**	E	E	Species	Low	Suitable foraging habitat within PCTs 3320 and 4025 although targeted survey did not detect species..	No impact	No impact	No impact
Pteropus poliocephalus **Grey-headed Flying-fox**	V	V	Ecosystem only (no breeding camps)	Recorded	Recorded foraging within proposal area and flying over but no camps present. Suitable foraging habitat	2.95 ha potential foraging habitat	2.62 ha potential foraging habitat	5.57 ha potential foraging habitat

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
					(flowering Eucalypts) within PCTs 3320 and 4025, and PNV.			
Saccolaimus flaviventris **Yellow-bellied Sheathtail-bat**	V	-	Ecosystem	Moderate	Suitable foraging, roosting and breeding habitat in all vegetation except pasture. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha foraging habitat. Removal of up to 34 tree hollows providing potential roosting habitat.
Scoteanax rueppellii **Greater Broad-nosed Bat**	V	-	Ecosystem	Recorded	Species recorded. Suitable foraging, roosting and breeding habitat in all vegetation except pasture. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat.	10.28 ha potential foraging habitat	4.34 ha potential foraging habitat	14.62 ha foraging habitat. Removal of up to 34 tree hollows providing potential roosting habitat.
Meridolum corneovirens **Cumberland Plain Land Snail**	E	-	Species	Low	Conservatively included although targeted survey did not detect	No impact	No impact	No impact

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha)		
						Stage 2A	Stage 2B	Total
					species. Marginal foraging and breeding habitat within PCT 3320 and 4025.			
Pommerhelix duralensis **Dural Land Snail**	E	E	Species	Low	Conservatively included although targeted survey did not detect species. Marginal foraging and breeding habitat within PCT 3320 and 4025.	No impact	No impact	No impact

5.1.3 Removal of threatened flora

No threatened plant species were identified from the targeted survey and the proposal will not directly impact on any known threatened plant species or habitat. Due to the limitations of survey, however, direct impacts to potential habitat are considered for threatened flora with potential to occur (Table 5.3). Although these species have a low potential to occur, pre-clearance survey is recommended in the area excluded from survey (Figure 2.4) to confirm that there are no threatened flora species in the proposal area.

Table 5.3: Summary of direct impacts on threatened flora

Species name	EPBC Act	BC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha or individuals)		
					Stage 2A	Stage 2B	Total
Acacia pubescens **Downy Wattle**	V	V	Low	Suitable habitat is restricted to PCTs 3320 and 4025, which are highly degraded. Proposal area is likely to be outside of species occurrence.	No impact anticipated. Not detected within survey area.	No impact anticipated. Not detected within survey area. 0.11 ha low potential habitat within area excluded from survey.	No impact anticipated. Not detected within survey area. 0.11 ha low potential habitat within area excluded from survey.
Cynanchum elegans **White-flowered Wax Plant**	E	E	Low	PCTs 3320 and 4025 provide very marginal habitat. This species prefers dry rainforest.			
Grevillea juniperina **subsp.** ***juniperina*** **Juniper-leaved Grevillea**	V	-	Low	Suitable habitat within PCTs 3320 and 4025.			
Hibbertia puberula	E	-	Low	Very marginal habitat, prefers dry sclerophyll on sandy soils rather than clay.			
Persoonia hirsuta **Hairy Geebung**	E	E	Low	PCTs 4025 and 3320 provides marginal habitat.			
Eucalyptus benthamii **Camden White Gum**	E	V	Low	PCT 4025 provides marginal habitat.	No impact anticipated. Not detected within survey area.	No impact anticipated. Not detected within survey area. <0.01 ha potential habitat within area excluded from survey.	No impact anticipated. Not detected within survey area. <0.01 ha potential habitat within area excluded from survey.

Species name	EPBC Act	BC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in proposal area	Impact (ha or individuals)		
					Stage 2A	Stage 2B	Total
***Haloragis exalata* subsp. *exalata* Square Raspwort**	V	V	Low	PCTs 4025 and 3975 provides marginal habitat.	No impact anticipated. Not detected within survey area.	No impact anticipated. Not detected within survey area. 0.11 ha low potential habitat within area excluded from survey.	No impact anticipated. Not detected within survey area. 0.11 ha potential habitat within area excluded from survey.
***Persicaria elatior* Tall Knotweed**	V	V	Low	Marginal habitat within PCT 3975.	No impact anticipated. Not detected within survey area.	No impact anticipated. Not detected within survey area.	No impact anticipated. Not detected within survey area.
***Pimelea spicata* Spiked Rice-flower**	E	E	Low	Marginal habitat within PCT 3320 due to high disturbance and weeds. Only old nearby records (1909) indicate this species may be locally extinct.	No impact anticipated. Not detected within survey area.	No impact anticipated. Not detected within survey area. 0.11 ha low potential habitat within area excluded from survey.	No impact anticipated. Not detected within survey area. 0.11 ha potential habitat within area excluded from survey.
***Pterostylis saxicola* Sydney Plains Greenhood**	E	E	Low	Marginal habitat within PCT 3320 due to high disturbance and weeds. Prefers soils with more sandstone influence.			

5.1.4 Aquatic impacts

The proposal has the potential to impact aquatic ecosystems during construction and operation due to the proximity of the proposal to the Hawkesbury River, Redbank Creek and lagoons on the Richmond Floodplain (Section 3.5) which contain in-stream habitat and riparian vegetation. As shown in Appendix B and Section 2.4.4, no threatened species listed under the FM Act are likely to occur in these waterbodies due to the lack of suitable habitat associated with threatened species. In consideration of the FM Act, and the associated documents, *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), aquatic impacts associated with the proposal are limited to Key Fish Habitat, which is identified within the proposal area associated with the above-mentioned waterbodies (see Section 2.4.4 and Table 2.8).

Potential impacts on aquatic habitat are assessed below in Table 5.4. It is a requirement under s.199 of the FM Act that the Minister (for Agriculture) be given written notice of the proposed work prior to the works taking place, and that consideration must be given to any matters raised by the Minister within 21 days of being given notice.

Table 5.4: Potential impacts to aquatic habitat

Potential impact	Details and discussion
Encroachment into Key Fish Habitat	The study area encompasses the Hawkesbury River, Redbank Creek and multiple lagoons, considered to be Type 1 Key Fish Habitat, as assessed in Section 3.5. The DPI maps the Hawkesbury River and

Potential impact	Details and discussion
	Redbank Creek as Key Fish Habitat (Figure 3.3). Lagoons along Kurrajong Road may also provide general habitat for fish. There will be no direct encroachment on Redbank Creek, and the biggest encroachment to Key Fish Habitat will be across the Hawkesbury River with the construction of piers across the water channel, which will directly impact 0.03 hectares of Key Fish Habitat. Lagoons along Kurrajong Road would have some minor encroachment along the existing road alignment. Impacts to DPI-mapped Key Fish Habitat are required to be offset in accordance with Transport No Net Loss Guidelines (2023a). Removal of riparian vegetation along the Hawkesbury River, and fringing macrophytes surrounding lagoons to facilitate the project construction has the potential to impact on connectivity and condition of said vegetation upstream and downstream of the impact area. Construction of permanent infrastructure can also introduce impervious surfaces to a previously vegetated or permeable areas (with associated effects on the hydrology of the area) and impact on water quality. Impacts to hydrology and water quality are discussed below.
Surface erosion and sedimentation	Any clearing of vegetation within the riparian zones or fringing wetlands / lagoons can result in reduction of soil stability. Additionally, the construction of bridge piers across the Hawkesbury River and the tributary of the Maree Maree Lagoon will potentially impact the stability of the river and lagoon beds depending on the suitability of local geotechnical conditions and how the construction is managed. Reduction in soil stability may cause surface erosion (sheet and gully erosion) and transportation of sediment overland into waterbodies and streams. Impacts may include increased water turbidity, which will disrupt light penetration through the water column and impact on primary (plant) production, with flow-on effects through the food web. Increased sediment loads may settle in downstream environments, smothering sessile invertebrates and causing a loss of deep habitat and changes to hydrologic connectivity. Sediment could also smother naturally rocky areas, resulting in a loss of habitat where macroinvertebrates shelter in the spaces between rocks.
Loss of riparian habitat	The study area includes the vegetated edge of the Hawkesbury River, Redbank Creek and several lagoons where there is wetland vegetation. Removal of this vegetation will result in the loss habitat for native fauna species as assessed in Section 5.1.2 of this BAR. Further impacts are loss of habitat and riparian vegetation connectivity and increased fragmentation of riparian habitat areas, introduction of exotic species, increased sedimentation and water quality issues.
Polluted surface water runoff	The construction of additional bridges and roadways over the river and lagoons will involve the construction of permanently impervious surfaces within the riparian zone. As a result, there is an increased risk of motor vehicle oils, litter and warmer surface water entering the river, as these substances will likely have previously been absorbed or stopped by permeable areas such as pasture and other vegetation. The intention of the design is to capture and treat surface runoff wherever possible. Subsequent impacts of an increase in surface water runoff due to the construction of impervious surfaces may include water quality issues (heavy metals, oil and grease pollution from vehicles), inorganic clogging of aquatic habitats (litter/rubbish) and destruction of macroinvertebrate communities (warm water inflows).
Increased velocity of surface water runoff	The project could also impact on the velocity of water entering the river and lagoons where impermeable surfaces are constructed over existing vegetation for bridge/road infrastructure or temporary clearing of areas for work sites. As noted above, the intention of the design is to slow, capture and treat surface runoff wherever possible. Impacts may include changes to instream flow velocity, which can change the aquatic habitat for invertebrates and other small aquatic fauna, increased bank erosion from fast discharge resulting in bed and bank erosion, loss of riparian vegetation, loss of edge habitat and sedimentation of downstream environments. Due to the size of the Hawkesbury River within the study area, the likelihood of a significant impact to the aquatic habitat as a result of an increase in the velocity of the surface water runoff entering the river is low. With implementation of best-practice stormwater management and infrastructure, runoff water velocity into the lagoons is also unlikely to increase.

5.1.5 Injury and mortality

Injury and mortality of fauna (Table 5.5) could occur during construction activities and can typically be managed through the development of specific and targeted measures as detailed in Section 6, including pre-clearing surveys undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*. All of these impacts are relevant to both Stage 2A and Stage 2B.

Table 5.5: Potential fauna injury or death

Action or scenario	Potential outcome for fauna	Species potentially impacted	Likelihood of impact & notes
Removal of vegetation and habitat	Fauna injury or death from crushing/smothering during clearance	• Non-threatened ground dwelling species • Non-threatened nocturnal species nesting/roosting in trees during the day (e.g. arboreal mammals and microbat species) • Threatened microbats roosting in tree hollows • Non-threatened aquatic species	Moderate. Less mobile species (ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (arboreal mammals and microbat species), may find it difficult to rapidly move away from the clearing activities when disturbed. The study area is only likely to contain a limited number of arboreal species (possums) and nesting birds that may be injured or killed during vegetation removal. Non-threatened reptiles, frogs, aquatic species and invertebrates may also be injured or killed during construction as habitat is cleared.
Temporary trenches, pits or stormwater swales	Fauna injury or death from entrapment leading to exposure, drowning or predation	• Non-threatened ground dwelling species	Moderate. Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided.
Machinery and plant operation	Fauna injury or death from being crushed or struck by machinery, entrapment in parked / stored machinery	• Non-threatened ground dwelling species • Threatened microbats	Low. 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.
Construction traffic	Fauna injury or death from vehicle strike.	• Non-threatened ground dwelling species (local records of native roadkill limited to Brushtail Possum and Red-bellied Black Snake; Kangaroos also possible) • Threatened microbats • Threatened birds including woodland birds, raptors and owls.	Low – not expected to increase level of traffic strikes significantly above current levels. Impact to threatened species expected to be minimal.

5.1.6 Groundwater dependent ecosystems

The following GDEs occur within the proposal area:

- PCT 3975 Southern Lower Floodplain Freshwater Wetland (obligate GDE).
- PCT 4025 Cumberland Red Gum Riverflat Forest (obligate GDE).
- PCT 3320 Cumberland Shale Plains Woodland. (facultative GDE).

The *Soils, Surface Water and Groundwater Report* (Aurecon 2023) identifies the following likely impacts on GDEs:

- Construction:
    - Impacts to aquatic and terrestrial GDEs through vegetation removal and earthworks.
    - Increased acidity of groundwater due to the disturbance of acid sulfate soils.
    - Potential groundwater contamination through accidental spills and incidents within construction compounds.
    - Intersections with groundwater, particularly at water quality basins and road cuts, and subsequent dewatering requirements to provide dry working conditions during construction.
    - Impacts to aquifers through piling works at bridge piles and noise wall piles (likely a low, short-term risk)
    - Monitoring of any discharges due to the detected marginally elevated concentrations of heavy metals in groundwater.
    - Potential geomorphological changes to the Hawkesbury River if excavation is required within the river bank.
- Operation:
    - Reduction in overall recharge to underlying aquifers due to increases in impermeable surfaces (unlikely to produce an effect that will constitute aquifer interference).
    - Leaching of heavy metals, hydrocarbons, oils and grease, and other contaminants into soils and groundwater from motor vehicles using the upgraded road network.
    - Terrestrial GDEs downstream of the proposal on the banks of the Hawkesbury River may be impacted by surface water contamination and seepage into the groundwater system.

The key impact to GDEs will be direct removal during construction, which has been assessed as removal of native vegetation in Section 5.1.1 and is not likely to be significant. The remaining impacts are not expected to materially affect GDEs given the existing altered hydrology associated with the existing road surfaces and man-made drainage features, and implementation of best-practice stormwater management and infrastructure.

5.1.7 Planted native vegetation

Planted native vegetation occurs throughout the proposal area and provides potential habitat for several threatened fauna species. A description of this vegetation is provided in Section 3.1.4

In accordance with BAM Appendix D.2, the suitability of the planted native vegetation (PNV) for use by threatened fauna species has been assessed in Table 5.6.

Table 5.6: Planted native vegetation habitat assessment for threatened fauna

Planted Native Vegetation component	Planted vegetation species present within proposal area	Threatened Species with potential to use
Seasonal fruiting and flowering resources	*Eucalyptus* spp. *C. maculata* *Syzygium* sp.	Grey-headed Flying Fox Regent Honeyeater Little Lorikeet Swift Parrot
Seeding feed trees	*Casuarina* spp.	Glossy-black Cockatoo
Insect foraging habitat	All PNV	Dusky Woodswallow Eastern Coastal Free-tailed Bat Regent Honeyeater Varied Sittella Large Bent-winged Bat (foraging) Little Bent-winged Bat (foraging) Eastern False Pipistrelle Yellow-bellied Sheathtail-bat Greater Broad-nosed Bat
Prey foraging habitat	All PNV, but specifically taller eucalypts	Powerful Owl Square-tailed Kite

Impacts to PNV are not likely to materially affect local threatened fauna given the highly modified condition and low ecological quality of the vegetation, and presence of similar or better-quality habitat within the locality. Measures to mitigate impacts on these species are detailed in Section 6 and include pre-clearance protocols to avoid direct impacts to any threatened fauna present within PNV.

Planted threatened flora species

One planted threatened flora species was recorded within the planted native vegetation to the east of the Hawkesbury River:

- *Macadamia tetraphylla*

This species is widely cultivated for the nut industry and is not indigenous to the area. Naturally populations occur in subtropical rainforest north from the Clarence River in Northern NSW. It is considered that the observed planted individuals are not of conservation significance and impacts to these individuals do not require further consideration or mitigation.

5.2 Indirect and operational impacts

Indirect impacts occur when the proposal or activities relating to the construction, operation and general change in land-use patterns of the proposal affect native vegetation, threatened ecological communities, threatened species and their habitats beyond the proposal area (direct impact area). Table 5.7 identify indirect and operational impacts relevant to the proposal, that are additional to the direct impacts described above.

Table 5.7: Indirect and operational impacts

Indirect impact	Impacted entities	Project phase/timing of impact	Likelihood and consequences
Edge effects	All retained vegetation within c. 10 m of development area. Coastal Wetlands.	Clearing, construction and ongoing	Likelihood: unlikely. Consequences: • Increase in water pollutants. • Increased soil nutrients from changes to runoff that may provide further opportunities for weeds. • Spill-over from noise, activity, scent and lighting effects

Indirect impact	Impacted entities	Project phase/timing of impact	Likelihood and consequences
			• Inappropriate use of remaining native vegetation areas such as additional clearing, dumping of materials and waste Edge effects are already highly prevalent within the proposal area due to the disturbed and patchy condition of vegetation, and urban and rural land uses. Whilst the proposal will increase edge effects slightly, it is not expected to substantially impact local biodiversity. Within the areas discharging to the lagoons that are mapped as Coastal Wetlands, road runoff would be treated during operation by a series of swales and operational basins. Whilst some reduction in water quality in these areas may occur during overtopping of these basins during severe weather events or flooding (Soils, Surface Water and Groundwater Working Paper, Aurecon 2024), the impacts to Coastal Wetlands are expected to be negligible.
Habitat fragmentation including removal of overhanging canopy	Arboreal mammals, small birds.	Clearing	Likelihood: moderate Consequence: • Very slight reduced cross-site movements by possums and small bird species The proposal area is already highly fragmented. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated.
Genetic isolation	None likely	Clearing and construction	Unlikely. The proposal area contains common and widespread species that can transfer genetic material over the small barrier provided by the new bridge and roads.
Timing of construction in relation to any fauna migration	Swift Parrot	Construction	Likelihood: moderate. The proposal will impact of remnant and planted Eucalypt species that may provide winter foraging habitat for Swift Parrot. This species migrates to the mainland from February to October and may utilise foraging resources within the proposal area depending on seasonal availability or these resources and those elsewhere. BioNet records indicate that this species does not necessarily visit the locality every migration (see Table D8, Appendix D). Important habitat for this species is mapped within the proposal area, and *E. tereticornis* and *E. moluccana* in particular provide foraging habitat. These tree species are most present in the north of the proposal area within PCT 3320. Impacts to this vegetation are minor and are unlikely to significantly impact the Swift Parrot due to the large area of similar vegetation directly adjacent to the study area. Avoidance of clearance of PCT 3320 between February and October will reduce the initial

Indirect impact	Impacted entities	Project phase/timing of impact	Likelihood and consequences
			impact on any Swift Parrot in the locality in that migratory season, but the long-term minor reduction of foraging habitat will still occur.
Reduction in habitat for breeding use by fauna	Threatened and non-threatened microbats. Nesting birds.	Clearance	Likelihood: moderate Impacts to vegetation and hollow-bearing trees outside of the breeding season will indirectly impact fauna that may use these resources for breeding habitat. Removal of hollow-bearing trees within the proposal area is considered to be minor due to the presence of similar resources in the surrounding area. To mitigate this impact a hollow replacement program is to replace any lost hollow resources as detailed in Section 6.
Injury and mortality	• Non-threatened ground dwelling species (local records of native roadkill limited to Brushtail Possum and Red-bellied Black Snake; Kangaroos also possible) • Threatened microbats • Threatened birds including woodland birds, raptors and owls.	Operation	Likelihood of ongoing vehicle strikes is high, but it is not expected to increase level of traffic strikes significantly above current levels. Impact to threatened species expected to be minimal.
Invasion and spread of weeds	Native vegetation, TECs and threatened fauna	Following clearing and construction	The study area already contains a high abundance of naturalised exotic species, many of which are classed as weeds, particularly Privet (*Ligustrum* spp.), Lantana (*Lantana camara*), Baloon Vine (*Cardiospermum grandiflorum*) and Japanese Honeysuckle (*Lonicera japonica*) (see all exotic and high-threat exotic species listed in Table A1; Appendix 1). Presence of weeds is strongly associated with past land management, particularly vegetation clearing, disturbance and agricultural use. Although it is expected that weed species will establish following clearance and earthworks associated with the proposal, it is not likely that this will substantially increase the prevalence of weeds in the study area or locality. Weeds should be managed during and post-construction to minimise weed spread.
Invasion and spread of pests	Native vegetation, TECs and threatened fauna	Clearing & construction	Likelihood: Low. The study area is currently habitat for a range of naturalised exotic species including Common Myna, Common Starling, Eurasian Blackbird, Black Rat, European Rabits, Foxes and Cats. Proposal activities have the low potential to disperse some pest species out of the proposal

Indirect impact	Impacted entities	Project phase/timing of impact	Likelihood and consequences
			area across the surrounding landscape, but these species are ubiquitous, and the magnitude of this impact will be low. Mitigation measures are not deemed necessary.
Invasion and spread of pathogens and disease	Native vegetation including TECs. Non-threatened frogs.	All phases	Several pathogens known from NSW have potential to impact on biodiversity as a result of their movement and infection during clearance and 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 will be managed within the proposal area according to the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024).*
Changes to surface hydrology	GDEs, Coastal Wetlands and wetland vegetation	All phases	The upgraded section of road subject to 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. A mix of basins and grassed swales will be used to manage and treat runoff. 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 within the study area.
Noise, light, dust and vibration	Roadside vegetation All local fauna, particularly nocturnal species.	All phases	Unlikely. A substantial increase in noise and vibration during operation of the road that will result in any increased impacts to biodiversity is unlikely. There is potential for minor impacts to locally non-threatened fauna from noise and vibration during construction, which may result in fauna temporarily avoiding habitats adjacent to the construction area. Ongoing lighting will also be provided at all intersections and the Castlereagh roundabout. Traffic noise is already

Indirect impact	Impacted entities	Project phase/timing of impact	Likelihood and consequences
			significant in the area and is likely to be a deterrent to most fauna groups already. The magnitude of this impact will be low and mitigation measures are not deemed necessary. Temporary and permanent lighting will be used at night to enable some work to be completed at intersections, and as part of traffic operation, that may result in impacts to nocturnal fauna. Nocturnal species such as possums and microbats may avoid the habitat in the proposal area where temporary lighting systems are used or permanent streetlights installed. This impact is considered minor given the existence of similar light sources in the proposal area. The magnitude of this impact will be low and mitigation measures are not deemed necessary.
Shading from newly constructed bridge	Native vegetation close to and underneath bridge, including TECs.	All phases	Likelihood: moderate. Shading may slow growth of certain species, while allowing shade-tolerant species to become more prevalent. Thus, there may be a slight change in species composition in areas close to and underneath the new bridge. Many native species are shade-tolerant, however, within the proposal area most shade-tolerant species are naturalised exotic species. It is likely that these weed species will continue to thrive in more shady conditions, but it is not likely that this will substantially increase their prevalence as they are already in high abundance in the vegetation close to the bridge. Weeds should be managed during and post-construction to minimise weed spread.

5.3 Cumulative impacts

This section of the report provides an analysis of the contribution of the proposal to ecological impacts in a local and regional context due to development. The impacts of other Transport proposals, major proposals and other large-scale proposals have been considered to an extent that is practical (Table 5.8).

Cumulative impacts should be considered in terms of vegetation and habitat removal, impacts on threatened species and ecological communities and water quality impacts as a minimum. Cumulative impacts will have a temporal and spatial scale. A cumulative impact assessment should consider impacts of both concurrent and future proposals (where these are known or can be anticipated).

The accumulating impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure will likely include continued loss of biodiversity on the Cumberland Plain. Within the Mitchell Landscapes included in the development area, the Hawkesbury - Nepean Channels and Floodplains, and the Hawkesbury - Nepean Terrace Gravels (Figure 1.1), 79% and 69% of native vegetation has been cleared, respectively. Due to the likely expansion of western Sydney and creation of housing and associated services and 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 presented in Table 5.8. Only Transport projects were identified within the locality – no major projects are currently proposed or are being assessed within the locality or Hawkesbury LGA.

Table 5.8: Present and future project/proposals

Project/proposal	Biodiversity value impacted
Investigations for the New Richmond Bridge and traffic improvements - Minor works REF for Geotechnical investigations January 2023.	No impacts to biodiversity values. Construction impacts are negligible as no vegetation clearing (except for minor trimming and traversing of groundcovers) is proposed. No impacts to threatened species.
New Richmond Bridge and traffic improvements – Stage 1 The Driftway	The proposal will directly remove 5.66 ha of native vegetation associated with the proposal area required for the upgrade works. This vegetation clearing includes: • About 0.51 ha of Shale Gravel Transition Forest in the Sydney Basin Bioregion EEC, under the BC Act • About 0.20 ha of Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion EEC, under the BC Act • About 0.37 ha of River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC, under the BC Act • About 3.41 ha of Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC, under the BC Act (0.45 moderate condition and 2.96 low condition) • About 1.17 ha of Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion Vulnerable Ecological Community (VEC), under the BC Act (0.08 moderate condition and 1.09 low condition). A total of 0.08 ha of this community meets the condition criteria for the EPBC Act listed Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion endangered ecological community, as this vegetation meets both the key diagnostic characteristics and the condition thresholds. • About 1.3 ha, approximately 5,000 specimens of *Dillwynia tenuifolia*. • 5.66 ha habitat for threatened fauna, including recorded Cumberland Plain Land Snail.
Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program Improvements on The Northern Road and Londonderry Road Flood Evacuation Routes – Biodiversity Assessment Report July 2024	Up to 20.93 hectares of remnant native vegetation, 1.42 hectares of planted native vegetation, and 0.26 hectares of planted non-native vegetation would be cleared for construction and operation. This vegetation clearing includes: • 2.82 hectares of 3320: Cumberland Shale Plains Woodland commensurate with Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC, under the BC Act • 6.8 hectares of PCT 3448: Castlereagh Ironbark Forest – commensurate in part with Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion EEC, under the BC Act (3.98 ha), and Cooks River/ Castlereagh Ironbark Forest – CEEC, under the EPBC Act (2.11 ha) • 0.5 hectares of PCT 3628: Castlereagh Shrubby Swamp Woodland – commensurate with Castlereagh Swamp Woodland, under the BC Act • 10.71 hectares of PCT 3629: Castlereagh Scribbly Gum Woodland – commensurate in part with Castlereagh Scribbly Gum Woodland VEC under the BC Act and Castlereagh Scribbly Gum and Agnes Banks Woodlands EEC under the EPBC Act (7.41 ha) • 0.10 hectares of PCT 4025: Cumberland Red Gum Riverflat Forest commensurate with River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC, under the BC Act • 1.42 hectares of planted native vegetation • Up to 10.68 ha of habitat for threatened flora species, including *Dillwynia tenuifolia, Grevillea juniperina* subsp. *juniperina, Marsdenia viridiflora* subsp. *viridiflora, Micromyrtus minutiflora, Persoonia nutans* and *Pultenaea parviflora* • Up to 22.61 hectares habitat for threatened fauna species, including Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet, Swift Parrot, Square-tailed Kite, Powerful Owl, Eastern False Pipistrelle, Eastern Coastal Freetailed Bat, Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis, Koala, Grey-headed Flyingfox, Yellow-bellied Sheathtail-bat, Greater Broad-nosed Bat and Cumberland Plain Land Snail.

When considered cumulatively, these projects combine to remove approximately 28.85 hectares of remnant native vegetation from the Cumberland Plain, all of which are NSW-listed TECs. This is a moderate to high cumulative impact when considering the already over-cleared landscape of the region. The impacts from the current proposal add 2.25 hectares of remnant native vegetation clearance to the cumulative impacts within the locality. However, given this vegetation is highly fragmented and contains high abundance of exotic species, the proposed vegetation clearance is not considered to significantly impact the local landscape or the local occurrence of the TECs or threatened species.

5.4 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 and nearby recent records.

Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species, 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 the assessment process. 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.

Full details of assessment of significance under the BC Act are presented in Appendix D: Tests of Significance (BC Act). Species with similar broad habitat requirements have been grouped together for assessment. The conclusions of the proposal area assessments are provided in Table 5.9, which indicates that a significant impact is considered unlikely on any threatened species or threatened ecological communities listed under the BC Act.

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* (DoE, 2013).The conclusions of the proposal area assessments under the EPBC Act are provided in Table 5.10.

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 (DoE, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (DoE, 2013). This advice has been considered while undertaking the assessments.

The results of both significance tests under the BC Act and the EPBC Act concluded that the current proposed development is unlikely to significantly affect the three TECs recorded within the proposal area. A significant impact is also unlikely for the threatened fauna species identified to have known or potential habitat within the study area.

Table 5.9: Summary of BC Act significance assessments findings

Significance assessment question *(per Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH 2018))*						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
TECs						
Cumberland Plain Woodland in the Sydney Basin Bioregion	-	N	N	-	Y	No
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	-	N	N	-	Y	No
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	-	N	N	-	Y	No
Woodland Birds						
Anthochaera Phrygia (Regent Honeyeater)	N	N	N	-	N	No
Artamus cyanopterus (Dusky Woodswallow)	N	N	N	-	N	No

Significance assessment question *(per Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH 2018))*						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
Daphoenositta chrysoptera (Varied Sittella)	N	N	N	-	N	No
Glossopsitta pusilla (Little Lorikeet)	N	N	N	-	N	No
Nectarivore/frugivore bat						
Pteropus poliocephalus (Grey-headed Flying-fox)	N	N	N	-	N	No
Microchiropteran bats						
Micronomus norfolkensis (Eastern Coastal Free-tailed bat)	N	N	N	-	N	No
Miniopterus orianae oceanensis (Large Bent-winged bat)	N	N	N	-	N	No
Myotis macropus (Southern Myotis)	N	N	N	-	N	No
Scoteanax rueppellii (Greater Broad-nosed Bat)	N	N	N	-	N	No
Falsistrellus tasmaniensis (Eastern false Pipistrelle)	N	N	N	-	N	No
Chalinolobus dwyeri (Large-eared Pied Bat)	N	N	N	-	N	No
Miniopterus australis (Little Bent-winged Bat)	N	N	N	-	N	No
Saccolaimus flaviventris (Yellow-bellied Sheathtail – Bat)	N	N	N	-	N	No
Birds with mapped important habitat						
Lathamus discolor (Swift Parrot)	N	N	N	-	N	No
Birds of Prey						
Lophoictinia isura (Square-tailed Kite)	N	N	N	-	N	No
Forest Owls						
Ninox strenua (Powerful Owl)	N	N	N	-	N	No
Ducks						
Oxyura australis (Blue-Billed Duck)	N	N	N	-	N	No
Stictonetta naevosa (Freckled Duck)	N	N	N	-	N	No
***Y** = Yes (negative impact), **N** = No (no or positive impact), **X** = Yes/No answer not applicable, **?** = unknown impact.*						

Table 5.10: Summary of EPBC Act significance assessments findings

Threatened species, or communities	Important population *(per Significant Impact Guidelines 1.1 (DoE 2013))*	Likely significant impact?
Lathamus discolor (Swift Parrot)	Yes	No
Anthochaera phrygia (Regent Honeyeater)	Yes	No
Pteropus poliocephalus (Grey-headed Flying-fox)	Yes	No
Chalinolobus dwyeri (Large-eared Pied Bat)	No	No
***Y** = Yes (negative impact), **N** = No (no or positive impact), **X** = Yes/No answer not applicable, **?** = unknown impact.*		

6. Mitigation

Once all practicable steps to avoid or minimise impacts have been implemented at the design phase, mitigation measures will be implemented to further lessen the potential biodiversity impacts of the proposal. These are outlined in Table 6.1 and have been considered in consultation with the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects* (2024), *NSW DPI (Fisheries) Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013), *Microbat Management Guidelines* (Transport 2023c) and *Wildlife Connectivity Guidelines for Road Projects* (RTA 2011).

Table 6.1: Mitigation measures

ID	Impact	Relevant stage	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B01	Removal of native vegetation and threatened ecological communities	2A and 2B	A Flora and Fauna Management Plan will be prepared in accordance with the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* and implemented as part of the Construction Environment Management Plan (CEMP). The FFMP will provide specific management for flora and fauna species (including threatened species) that will include but not be limited to: ▪ Construction personnel are to be informed of the environmentally sensitive aspects of the proposal area relating to Cumberland Plain Woodland, River-flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains TECs. ▪ Delineation of work zones, areas for parking and turning of vehicles and plant equipment prior to commencement of works. ▪ Establishment of exclusion zones around Coastal Wetland areas. ▪ Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines. ▪ Periodic monitoring will be undertaken to ensure all controls are in place and no inadvertent impacts are occurring. ▪ If any damage occurs to vegetation outside of the nominated work area, Transport will be notified so that appropriate remediation strategies can be developed.	Prior to construction	Effective	2.25 ha remnant native vegetation	Contractors
B02		2A and 2B	Native vegetation removal, including Cumberland Plain Woodland, River-flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains TEC vegetation, will be minimised through detailed design.	Detailed design	Effective		Designer Contractor
B03		2A and 2B	Construction activities are to prioritise use of cleared areas where no remnant native vegetation occurs (i.e. grassland and/or exotic vegetation), including avoiding PCT 3975 Freshwater Wetland vegetation within WSU lands.	During construction	Effective		Contractor
B04		2A and 2B	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective		Contractors

ID	Impact	Relevant stage	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B05		2A and 2B	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	Detailed design, Construction and Post construction	Effective		Transport and Contractors
B06		2A and 2B	The unexpected species find procedure is to be followed under *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal area.	During construction	Proven		Contractors
B07		2A and 2B	The final biodiversity offset requirement for the proposal is to be determined during detailed design and development of a biodiversity offset strategy (BOS) in accordance with Transport (2023a) No net loss guidelines.	Design	Effective		Transport
B08	Removal of threatened fauna habitat	2A and 2B	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	Prior to construction and during construction	Effective	0.55–14.62 ha depending on species (see Table 5.2)	Contractors
B09		2A and 2B	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective		Contractors
B10		2A and 2B	Habitat removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective		Contractors
B11		2A and 2B	Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Proven		Contractors
B12		2A and 2B	The unexpected species find procedure is to be followed under *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal area.	During construction	Proven		Contractors

ID	Impact	Relevant stage	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B13		2A and 2B	A Tree and Hollow Replacement Plan is to be prepared in accordance with the Transport *Tree and Hollow Replacement Guidelines* (Transport 2023d).	Prior to construction	Effective		Transport
B14	Removal of threatened flora	2A and 2B	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* targeting species identified below. The following species should be targeted in areas excluded from survey (can be surveyed across all months): • *Acacia pubescens* (Downy Wattle) - PCT 3320 • *Cynanchum elegans* (White-flowered Wax Plant) - PCTs 3320, 4025 • *Eucalyptus benthamii* (Camden White Gum) - PCTs 3320, 4025 • *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea) - PCTs 3320, 4025 • *Haloragis exalata* subsp. *exalata* (Square Raspwort) - PCTs 3975, 4025 • *Persoonia hirsuta* (Hairy Geebung) - PCT 4025 The following species have specific survey periods and therefore a habitat assessment is recommended if surveys are undertaken outside the specified survey periods: • *Hibbertia puberula* - PCT 3320 (Oct-Dec) • *Persicaria elatior* (Tall Knotweed) - PCT 3975 (Dec-May) • *Pterostylis saxicola* (Sydney Plains Greenhood) - PCT 3320 (Oct) This species should be targeted for pre-clearing surveys in all areas of the identified PCTs (all months, 4 weeks after at least a 30 mm rainfall event): • *Pimelea spicata* (Spiked Rice-flower) - PCTs 3320 and 4025	Prior to construction	Proven	None anticipated	Contractors
B15		2A and 2B	The unexpected species find procedure is to be followed under *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal area.	During construction	Proven		Contractors

ID	Impact	Relevant stage	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B16	Impacts to threatened microbats	2A and 2B	• The unexpected species find procedure is to be followed under *Guide 1: Pre-clearing process* of the ***Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*** if threatened microbat species are identified in the proposal area.	Prior to construction	Effective	None anticipated	Contractors/Transport
B17	Aquatic impacts	2A and 2B	Where possible, impacts to aquatic habitat will be minimised through detailed design, including: • Maintaining fish passage in accordance with *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). • Use of cofferdams for de-watering, diversion, or damming of water. • Appropriate stormwater design to reduce runoff, pollutants and sediment inputs into aquatic habitats. • Appropriate temporary and permanent erosion and sediment controls, including bank stabilisation, sediment booms, sediment fencing and sediment ponds.	Detailed design and during construction	Effective	Minor	Transport & contractor
B18		2A and 2B	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	During construction	Effective		Transport & contractors
B19		2A and 2B	Consultation with DPI Fisheries to determine offset requirements for the proposed impacts on Key Fish Habitat.	Pre-construction	Effective		Transport
B20	Indirect impacts to Coastal Wetlands	2A and 2B	Exclusion zones are to be established within the proposal area to protect Coastal Wetland areas.	During construction	Effective		
B21			Detailed design is to ensure no indirect impacts to Coastal Wetlands.	Detailed design	Effective	Insignificant	Transport

ID	Impact	Relevant stage	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B22	Impacts to Proximity Areas to Coastal Wetlands	2A and 2B	Detailed design is to minimise impacts to the Proximity Areas to Coastal Wetlands	Detailed design	Effective	Minor	Transport
B23	Groundwater dependent ecosystems	2A and 2B	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Detailed design	Effective	Minor	Transport
B24	Changes to hydrology	2A and 2B	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective	Minor	Transport
B25	Edge effects on adjacent native vegetation and habitat	2A and 2B	Exclusion zones will be set up at the limit of clearing in accordance *with Guide 2: Exclusion zones* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective	Insignificant	Contractors
B26	Injury and mortality of fauna	2A and 2B	Fauna will be managed in accordance with *Guide 9: Fauna* handling of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective	Minor	Contractors
B27	Invasion and spread of weeds	2A and 2B	Weed species will be managed in accordance *with Guide 6: Weed management* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective	Insignificant	Contractors
B28	Invasion and spread of pathogens and disease	2A and 2B	Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)*.	During construction	Effective	Insignificant	Contractors
B29	Noise, light, dust and vibration	2A and 2B	Shading and artificial light impacts will be minimised through detailed design.	Detailed design	Effective	Insignificant	Transport & contractors

7. Offsets and other measures

Impacts that require the provision of biodiversity offsets, conservation measures or tree and hollow replacement are assessed below in accordance with:

- No Net Loss Guidelines and supporting resources (Transport 2023a).
- Tree and Hollow Replacement Guidelines and supporting resources (Transport 2023d).

7.1 Thresholds

This section identifies the biodiversity impacts that trigger thresholds set out by No Net Loss Guidelines (Transport 2023a). Residual impacts that do not exceed offset thresholds must then consider the requirements of the Tree and Hollow Replacement Guidelines (Transport 2023d). The direct impacts that require offsetting and any residual impacts that may be subject to tree and hollow replacement (or if works/impacts are excluded in accordance with each guideline) are identified in Table 7.1. Note that 'Moderate to good' condition vegetation is defined in Section 2.3.2 of this BAR.

Table 7.1: Offset thresholds (Transport No Net Loss Guidelines)

Impact	Threshold
Works involving clearing of a CEEC	Where there is any clearing of an CEEC in 'moderate to good' condition
Works involving clearing of an EEC	Where clearing of a EEC ≥ 2 ha in 'moderate to good' condition
Works involving clearing of VEC	Where clearing of VEC ≥ 5 ha in 'moderate to good' condition
Works involving clearing of any habitat for a known species credit fauna species or clearing of breeding habitat (as defined by the TBDC) for dual-credit fauna species (excluding exotic and planted vegetation that cannot be assigned to a plant community type)	Where clearing ≥ 1 ha in 'moderate to good' condition
Works involving removal of known threatened flora species and their habitat	Where loss of individuals is ≥10 or where clearing of habitat is ≥ 1 ha
Type 1 or Type 2 Key Fish Habitats	Where there is a net loss of habitat
Any residual biodiversity impact that doesn't require offsets in accordance with the No Net Loss Guideline is to be assessed against the requirements of the Tree and Hollow Replacement Guideline.	Any clearing of hollows and/or trees ≥5cm DBH

Table 7.2: Assessment of vegetation impacts against thresholds

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha)			Threshold triggered?
				Stage 2A	Stage 2B	Total	
Zone 1	3320 Cumberland Shale Plains Woodland	Low-moderate	Critically Endangered (BC Act); does not meet EPBC condition thresholds	0.03	0.31	0.34	Offsets required. Clearing of a CEEC in 'moderate to good' condition –

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha)			Threshold triggered?
				Stage 2A	Stage 2B	Total	
							this vegetation must be classed as 'moderate to good' as tree cover is not <25% of the tree cover benchmark for the PCT.
Zone 2	4025 Cumberland Red Gum Riverflat Forest	Low-moderate	Endangered (BC Act); does not meet EPBC condition thresholds	1.29	0.07	1.36	No offsets required for TEC: <2 ha impact. Offsets required for threatened fauna habitat. Tree and hollow replacement is also required.
Zone 3	3975 Southern Lower Floodplain Freshwater Wetland	Low-moderate	Endangered (BC Act)	0.54	0.01	0.55	No offsets required for TEC: <1 ha impact. Offsets required for threatened fauna habitat. Tree replacement is required.
Zone 4	Planted native vegetation	Low	Not a TEC	1.63	2.24	3.87	No offsets required: Low condition. Tree and hollow replacement is required.
Zone 5	Exotic trees and shrubs	Low	Not a TEC	6.79	1.71	13.32	No offsets required: Low condition. Tree and hollow replacement is required.
Zone 6	Exotic pasture and lawn	Low	Not a TEC	29.23	6.09	35.32	No offsets required: Low condition. Tree and hollow replacement is not required.

7.2 Preliminary offset and tree/hollow replacement calculations

7.2.1 Preliminary offset calculations

This section provides a preliminary calculation of offsets for each impact triggering a threshold identified in Section 7.1. Offsets for terrestrial impacts (i.e. threatened species and ecological communities listed under the BC Act and EPBC Act) are preliminarily calculated as credits using the BAM-C. Copies of the relevant BAM-C credit reports are provided in Appendix F: Biodiversity credit reports. These offsets have been determined in accordance with Part 6 of the Biodiversity Conservation Regulation (2017).

Calculation of tree and hollow replacement requirements requires counting trees and hollows within areas that do not require offsetting. A preliminary estimate has been made based on tree size and hollow data collected in BAM plots conducted within each required vegetation zone.

Table 7.3: Preliminary ecosystem credit calculations for impacts to threatened ecological communities

Plant community type	EPBC Act	BC Act	VI score	BRW	HBT	Impact (ha)	Ecosystem credits
PCT 3320 Cumberland Shale Plains Woodland	n/a	Cumberland Plain Woodland in the Sydney Basin Bioregion	42.8	2.5	Yes	0.34	9
Total ecosystem credits							9

Table 7.4: Preliminary credit calculations for impacts to species-credit species

Species name	EPBC Act	BC Act	Impact (ha)[1]	Species credits
Lathamus discolor / Swift Parrot	E	CE	0.93	23
Myotis macropus / Southern Myotis	V	-	1.9 (rounded down by BAM-C from 1.91)	38
Total species credits				61

[1]Note: the BAM-C rounds up some values, hence the discrepancies with other parts of this BAR.

7.2.2 Preliminary tree and hollow replacement estimates

The requirement to replace trees and hollows removed are assessed here against the requirements of the Tree and Hollow Replacement Guidelines (Transport 2023d). This includes all vegetation clearing that does not trigger an offset threshold and is not covered by the exclusions in Section 1.4 of the guidelines. The following vegetation zones do not trigger the offset thresholds for ecosystem credits but do require preliminary estimates for tree and hollow replacement:

- Zone 2 4025 Cumberland Red Gum Riverflat Forest
- Zone 3 3975 Southern Lower Floodplain Freshwater Wetland
- Zone 4 Planted native vegetation
- Exotic amenity trees within Zone 5

Tree and hollow replacement requirements have been estimated using the BAM plot data. As trees in >80 centimetres DBH class were not measured during surveys, all must be assumed to be >100 centimetres DBH for the purpose of the tree count estimate. An average of the plot data provides a representative estimate of the number of trees in each stem size class, and the number of hollows, in each vegetation zone that is subject to tree and hollow replacement.

Exotic amenity trees have not been individually recorded but plot data has been used to estimate numbers of exotic trees in areas of known amenity. Exotic trees larger than 20 cm DBH were treated as amenity trees for this purpose. The proposal area contains many large exotic trees that have been planted presumably to provide amenity value, and their removal is likely to

reduce the amenity value of the locality. This is particularly the case for roadside poplars (Photo 3.11) and areas of Hannah Park (Photo 3.12). Recorded hollows, including those within exotic trees, are mapped on Figure 2.3.

Table 7.5: Average counts of trees and hollows and estimates per hectare

Veg. zone	Impact (ha)	Plots	Average number of trees in stem size classes (cm) and hollows per ha[1]					Average count of tree and hollows in impact area[2]				
			5-19	20-49	50-99	>100	Hollows	5-19	20-49	50-99	>100	Hollows
2	1.36	Plot 9	180	200	20	0	10	245	272	27	0	14
3	0.55	Plots 11 & 14	35	55	5	0	0	19	30	3	0	0
4	3.87	Plots 4, 7 & 15	110	143	30	3	7	426	555	116	13	26
n/a (Exotic trees & shrubs	8.5	Plots 5, 10, 12 & 13	0	22	12	0	1.4	0	187	102	0	12[3]

NOTE 1: Calculated by the average from the plot data (assuming standard 0.1 ha plot) multiplied by a factor of 10
NOTE 2: Calculated by the average/ha multiplied by the impact
NOTE 3: Based on count of recorded hollows within exotic vegetation

Table 7.6: Preliminary estimates of trees and hollow replacement requirements

Category	Estimated No. impacted		Replacement requirement per tree/hollow removed[1]		Estimated number to be replaced[2]		Estimated equivalent payment to Transport conservation fund[2]
	Native trees	Exotic amenity trees	Planting required	Contribution required	Native trees	Exotic amenity trees	
Very large tree (DBH ≥100cm)	13	0	Plant minimum 16 trees	$2,500	208	0	$32,500
Large tree (DBH ≥50 to <100cm)	146	102	Plant minimum 8 trees	$1,000	1168	816	$248,000
Medium tree (DBH ≥20 to <50 cm)	857	187	Plant minimum 4 trees	$500	3436	748	$522,000
Small tree (DBH ≥ 5cm to <20 cm)	690	0	Plant minimum 2 trees	$125	1383	0	$86,250
			Subtotal (Trees)		6195	1564	$888,750
Hollow	40	12	Provide 3 artificial hollows for every occupied hollow removed*	$500	24	7	$5,200
			Subtotal (Hollows)		24	7	$5,200
			Totals		7389		$893,950

Category	Estimated No. impacted		Replacement requirement per tree/hollow removed[1]		Estimated number to be replaced[2]		Estimated equivalent payment to Transport conservation fund[2]
	Native trees	Exotic amenity trees	Planting required	Contribution required	Native trees	Exotic amenity trees	

NOTE 1: As per the Transport Tree and Hollow Replacement Guidelines

NOTE 2: An equivalent payment to the Transport Conservation Fund can be used where replanting is not feasible or fully achievable within the project boundary or adjacent land.

**Assume 20% occupancy rate. For every five hollows identified (or where less than five hollows will be impacted), assume one hollow will be occupied and requires replacement. Where hollows are inspected during the clearing process, actual occupation can used as the basis for the replacement requirement.*

7.2.3 Preliminary offsets for Key Fish Habitat (KFH)

The Policy and guidelines for fish habitat conservation and management (DPI 2013) includes a description of DPI Fisheries' 'no net loss of Key Fish Habitat' policy, where environmental impacts on aquatic habitat (direct and indirect) are to be offset. NSW DPI calculates habitat compensation on a minimum 2:1 basis for all Key Fish Habitat. Where 'no net loss' of Key Fish Habitat cannot be achieved, offset fees apply. Transport offset thresholds apply to Key Fish Habitat Types 1 and 2 (Table 3.17) and only impacts to DPI-mapped Key Fish Habitat are required to be offset in accordance with Transport No Net Loss Guidelines (2023a). 0.03 hectares of Key Fish Habitat will be directly impacted during construction of bridge pylons across the Hawkesbury River. Consultation with DPI Fisheries will be required to determine the offset requirements for the proposed works.

7.3 Biodiversity offset strategy/tree and hollow replacement plan

The final offset requirement for the proposal is to be determined during detailed design and development of the biodiversity offset strategy (BOS). During the detailed design phase, the proposal area may change from that assessed in this BAR which will result in a change to the offset requirements for the proposal. A Tree and Hollow Replacement Plan is also to be prepared in accordance with the Transport Tree and Hollow Replacement Guidelines.

The BOS will include offsets for Key Fish Habitat determined in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)* (DPI (Fisheries) 2013) and in consultation with DPI.

8. Conclusion

The vegetation in the proposal area is comprised of six vegetation zones, including three remnant Plant Community Types (PCTs), one planted native vegetation zone and two exotic zones. All vegetation is in low or low-moderate condition with high abundance of exotic species.

The proposal is not likely to have a significant impact on threatened entities. However, the proposal will have direct and indirect impacts on biodiversity during the construction and operational phases of the development. The proposal will require removal of around 6.12 hectares of native vegetation, 8.50 hectares of exotic trees and shrubs, and 35.32 hectares exotic pasture and lawn, which includes the following impacts:

- PCT 3320 Cumberland Shale Plains Woodland equivalent to TEC Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (Critically Endangered): 0.34 hectares
- PCT 4025 Cumberland Red Gum Riverflat Forest equivalent to River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) (Endangered): 1.36 hectares
- PCT 3975 Southern Lower Floodplain Freshwater Wetland equivalent to Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)(Endangered): 0.55 hectares
- Planted native vegetation: 3.87 hectares
- Up to 0.11 hectares low potential habitat for threatened flora within area excluded from survey
- Up to 14.62 hectares of known or potential habitat for threatened fauna

No naturally occurring threatened flora species were observed within the proposal area. One planted threatened species, *Macadamia integrifolia* (Macadamia Nut), was observed, but as the observed individuals are planted they are not of conservation importance.

Five threatened fauna species were recorded within the study area: Eastern Coastal Free-tailed Bat, Large Bent-winged Bat, Southern Myotis, Grey-headed Flying-fox and Greater Broad-nosed Bat. All these species are listed under the BC Act as Vulnerable, while Grey-headed Flying-fox is also listed under the EPBC Act as Vulnerable. Important Habitat for Swift Parrot (BC Act: Endangered; EPBC Act Critically Endangered) is mapped within the proposal area.

The habitats within the proposal area are highly modified and of low or low-moderate quality, and do not possess important habitat features critical to the persistence of the threatened fauna species recorded or predicted from the locality. Significance assessments under the BC Act and EPBC Act found that the proposal will not result in a significant impact on threatened species (Appendices D and F).

No suitable habitat for threatened marine or aquatic species is present in the study area, but Key Fish Habitat will be impacted.

Transport's 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 proposal, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate.

Internal offset thresholds are met by the proposal for TECs, threatened fauna habitat and Key Fish Habitat (No Net Loss Guidelines 2023a). Preliminary offset calculations are summarised as follows:

- 0.34 hectares impact on 3320 Cumberland Shale Plains Woodland equivalent to 9 ecosystem credits
- 0.93 hectares impact on Swift Parrot mapped Important Habitat equivalent to 23 species credits
- 1.91 hectares impact on Southern Myotis habitat equivalent to 38 species credits
- 0.03 hectares Key Fish Habitat through consultation with DPI.

Preliminary estimates for tree and hollow replacement are as follows in accordance with the Transport Biodiversity Policy:

- 6195 native trees and 1564 exotic amenity trees equivalent to $888,750 payment into Transport conservation fund
- 31 artificial replacement hollows, equivalent to $5,200 payment into Transport conservation fund.

9. Glossary

Table 9.1: Glossary of terms

Term	Definition
Accredited person or assessor	Means as person accredited under section 6.10 (of the BC Act) to prepare reports in accordance with the BAM.
Biodiversity Assessment Method	The Biodiversity Assessment Method is established under section 6.7 of the BC Act. The BAM is established for the purpose of assessing certain impacts on threatened species and threatened ecological communities (TECs), and their habitats, and the impact on biodiversity values.
Biodiversity Assessment Method Calculator	Biodiversity Assessment Method Calculator (BAM-C) – the online computer program that provides decision support to assessors and proponents by applying the BAM and referred to as the BAM-C. The BAM-C contains biodiversity data from the BioNet Vegetation Classification and the Threatened Biodiversity Data Collection that the assessor is required to use in a BAM assessment. The BAM-C applies the equations used in the BAM, including those to determine the number and class of biodiversity credits required to offset the impacts of a development, or created at a biodiversity stewardship site. It is published by the Department (DPIE 2020a).
Biodiversity credit report	The report produced by the BAM-C that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (DPIE 2020a).
Biodiversity offsets	The gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development (DPIE 2020a).
Biodiversity Offsets and Agreement Management System	The online system used to administer the Biodiversity Offsets Scheme. The BOAMS is used by accredited assessors (to carry out specific BAM-related tasks involving access to the BAM-C to perform assessments, submit data, generate credits and calculate a credit price), by landholders (to apply for a Biodiversity Stewardship Agreement and manage ongoing reporting obligations for their agreement) and by proponents of developments (to view their credit obligation or the payment required to the Biodiversity Conservation Fund).
Biodiversity risk weighting	A factor of the formulas used by the BAM to calculate credits. The biodiversity risk weighting (BRW) is a score given to each vegetation zone and species based on the 'sensitivity to loss' versus the 'sensitivity to gain'. The value is set for threatened species and listed in the TBDC. The BRW for vegetation is calculated for each vegetation zone by the BAM-C using a factor of the 'sensitivity to loss' of the PCT or TEC (located in the BioNet vegetation classification) and the 'sensitivity to gain' of the ecosystem credit species (in the TBDC) that are predicted to occur.
Biodiversity Stewardship site	Refers to land which is the subject to a Biodiversity Stewardship Agreement under the BC Act.
BioNet Atlas	The DPIE database of flora and fauna records (formerly known as the NSW Wildlife Atlas). The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails listed under the BC Act) and some fish (DPIE 2020a).
BioNet Vegetation classification	Refers to the vegetation community-level classification for use in vegetation mapping programs and regulatory biodiversity impact assessment frameworks in NSW. Refer About BioNet Vegetation Classification | NSW Environment and Heritage (DPE 2020a).

Term	Definition
Construction footprint	The area to be directly impacted by the proposal during construction activities. See also definition for proposal area.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (the BC Regulation) (DPIE 2020a).
Ecosystem credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for ecosystem credits. This is analogous with the definition of 'predicted species'.
Ecosystem credits	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity certification site and the gain in biodiversity values at a biodiversity stewardship site (DPIE 2020a).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (DPIE 2020a).
Indirect impact	Impacts that occur when the proposal affects native vegetation and threatened species habitat beyond the proposal area or within retained areas (e.g. transporting weeds or pathogens, dumping rubbish). This includes impacts from activities related to the construction or operational phase of the proposal and prescribed impacts (DPIE 2020a).
Landscape assessment area	The area which includes the proposal area and a 1500 m buffer surrounding the outside edge of the boundary of the proposal area or 500 m along each side of the centre line of a linear-shaped proposal
Local population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions: • *The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.* • *The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.* • *The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time or return year to year (OEH 2018).*
Matter of national environmental significance	A matter of national environmental significance (MNES) is any of the nine defined components protected by a provision of Part 3 of the EPBC Act (Commonwealth).
Mitigation	Action to reduce the severity of an impact.

Term	Definition
Native vegetation	Has the same meaning as in section 1.6 of the BC Act and section 60B of the LLS Act. In summary, a) trees (including any sapling or shrub or any scrub) b) understorey plants c) groundcover (being any type of herbaceous vegetation) d) plants occurring in a wetland. A plant is native to New South Wales if it was established in New South Wales before European settlement (BC Act). Native vegetation does not extend to marine vegetation (being mangroves, seagrasses or any other species of plant that at any time in its life cycle must inhabit water other than fresh water). Marine vegetation is covered by the provisions of the FM Act.
NSW (Mitchell) landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (DPIE 2020a).
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Patch size	Under the BAM, patch size is defined as an area of native vegetation that: • *occurs on the development site or biodiversity stewardship site* • *includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems).* Patch size may extend onto adjoining land that is not part of the development site or biodiversity stewardship site (DPIE 2020a). For assessing Threatened Ecological Communities (TECs) listed under the EPBC act, a patch is defined as a discrete and mostly continuous area of an ecological community; it can include small-scale variations, gaps and disturbances but permanent man-made structures, such as roads and buildings, are typically excluded from a patch.
PlantNET	An online database of the flora of New South Wales which contains currently accepted taxonomy for plants found in the State, both native and exotic.
Population	A group of organisms, all of the same species, occupying a particular area (DPIE 2020a).
Spatial datasets	Spatial databases required to prepare a BAR • *BioNet NSW (Mitchell) Landscapes – Version 3.1* • *NSW Interim Biogeographic Regions of Australia (IBRA region and sub-regions) – Version 7* • *NSW soil profiles* • *hydrogeological landscapes* • *acid sulfate soils risk* • *digital cadastral database* • *Vegetation Information Systems maps* • *Geological sites of NSW.*
Species credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits (DPIE 2020a). This is analogous with the definition of 'candidate species'.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection (DPIE 2020a).

Term	Definition
Species polygon	An area of land identified in Chapter 5 (of the BAM) that contains habitat or is occupied by a threatened species (DPIE 2020a).
Study area	The area directly affected by the proposal (proposal area or construction footprint) and any additional areas likely to be affected by the proposal, either directly or indirectly.
Proposal area	Land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal. It excludes the landscape assessment area which surrounds the proposal area (i.e., the area of land in the 1500 m buffer zone around the proposal area or 500m buffer zone for linear proposals). In the case of a biodiversity certification proposal, proposal area includes the biodiversity certification assessment area (DPIE 2020a). See also definition for construction footprint.
Threatened Biodiversity Data Collection	A publicly assessable online database (registration required) which contains information for listed threatened species, populations and ecological communities (DPIE 2020a). Part of the BioNet database, published by the EHG and accessible from the BioNet website at www.bionet.nsw.gov.au.
Vegetation integrity (score)	The condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT. The vegetation integrity score is the quantitative measure of vegetation condition calculated by the BAM-C (DPIE 2020a).
Vegetation zone	A relatively homogeneous area of native vegetation on a development site, clearing site, land to be biodiversity certified or biodiversity stewardship site that is the same PCT and has the same broad condition state (DPIE 2020a).

10. Abbreviations

Term	Definition
AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method calculator
BC Act	Biodiversity Conservation Act 2016 (NSW)
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offset Scheme
BRW	Biodiversity risk weighting
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DIWA	Directory of Important Wetlands in Australia
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EHG	NSW Environment and Heritage Group within the Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	*Environment Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
Fisheries NSW Policy and guidelines	Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of national environmental significance
PCT	Plant community type
PMST	Protected Matters Search Tool
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened ecological communities (VECs, EECs and CEECs)
Transport	Transport for NSW
VEC	Vulnerable Ecological Community

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Appendix A: Species recorded

Table A1: Recorded flora

Family	Scientific Name	Common Name	Form	% cover														
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Alismataceae	*Alisma plantago-aquatica*	Water Plantain	Forb (FG)											0.1				
Alliaceae	*Nothoscordum borbonicum*	Onion Weed	Exotic				0.1								0.1			
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	Forb (FG)				0.1										3	0.1
Anacardiaceae	*Schinus molle var. areira*	Pepper Tree	Exotic															1
Anacardiaceae	*Toxicodendron succedaneum*	Rhus Tree	Exotic	1										0.1				
Apiaceae	*Ammi majus*	Bishop's Weed	Exotic									0.1						
Apiaceae	*Centella asiatica*	Indian Pennywort	Forb (FG)						0.1					0.1				
Apiaceae	*Daucus carota*	Wild Carrot	Exotic			0.1	0.1									0.1	0.1	
Apocynaceae	*Araujia sericifera*	Moth Vine	HTW - Manageable	0.1						2	0.1				0.1			0.1
Arecaceae	Syagrus romanzoffiana	Cocos Palm	Exotic							2								
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	HTW															0.1
Asteraceae	*Ambrosia artemisiifolia*	Annual Ragweed	Exotic									0.1						
Asteraceae	*Aster subulatus*	Wild Aster	Exotic			0.1	0.1	0.1						0.1	1	0.1	1	
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	Exotic										0.1					
Asteraceae	*Calotis hispidula*	Bogan Flea	Forb (FG)														0.1	
Asteraceae	*Calotis hispidula*	Bogan Flea	Forb (FG)				0.1											
Asteraceae	*Cichorium endivia*	Endive	Exotic							0.1						2	1	
Asteraceae	*Cirsium vulgare*	Spear Thistle	Exotic				0.1				2				0.1	0.1	0.1	10
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	Exotic			0.1	0.1	0.1		0.1		0.1	0.1	0.1		0.1	1	
Asteraceae	*Gamochaeta spp.*		Exotic			0.1	0.1	0.1	0.1							0.1	0.1	
Asteraceae	*Gazania rigens*		HTW									0.1						
Asteraceae	*Hypochaeris radicata*	Catsear	Exotic			0.2	0.1	0.1	0.1		0.1					1		
Asteraceae	*Lactuca saligna*	Willow-leaved Lettuce	Exotic													0.1	0.1	
Asteraceae	*Senecio madagascariensis*	Fireweed	HTW				0.1	0.1	3							0.1		
Asteraceae	*Soliva sessilis*	Bindyi	Exotic			1	0.1	0.1						0.1				

Family	Scientific Name	Common Name	Form	% cover														
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	Exotic				0.1				0.1					0.1	0.1	0.1
Asteraceae	*Taraxacum officinale*	Dandelion	Exotic	0.1			0.1	0.1			0.1				0.1	0.1		
Asteraceae	*Tragopogon porrifolius subsp. porrifolius*	Salsify	Exotic								0.1		0.1					
Basellaceae	*Anredera cordifolia*	Madeira Vine	HTW							2		2						
Bignoniaceae	*Dolichandra unguis-cati*		Exotic		10					2			10					
Bignoniaceae	*Jacaranda mimosifolia*	Jacaranda	Exotic					10										
Brassicaceae	*Brassica fruticulosa*	Twiggy Turnip	Exotic															0.1
Brassicaceae	*Brassica nigra*	Black Mustard	Exotic							0.1	0.1	0.1						
Brassicaceae	*Rorippa palustris*	Yellow Cress	Exotic											1			0.1	
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell	Forb (FG)						0.1									
Caprifoliaceae	*Lonicera japonica*	Japanese Honeysuckle	HTW							3						1		
Caryophyllaceae	*Cerastium fontanum subsp. fontanum*		Exotic			0.1	0.1		0.1									
Caryophyllaceae	*Cerastium glomeratum*	Mouse-ear Chickweed	Exotic											0.1				
Caryophyllaceae	*Paronychia brasiliana*	Chilean Whitlow Wort, Brazilian Whitlow	Exotic					0.1										
Caryophyllaceae	*Polycarpon tetraphyllum*	Four-leaved Allseed	Exotic				0.1	0.1										
Casuarinaceae	*Casuarina cunninghamiana subsp. cunninghamiana*	River Oak	Tree (TG)									20	5					
Casuarinaceae	*Casuarina glauca*	Swamp Oak	Tree (TG)	5														60
Clusiaceae	*Hypericum gramineum*	Small St John's Wort	Forb (FG)						0.1									
Commelinaceae	*Tradescantia fluminensis*	Wandering Jew	HTW		0.4							30						2
Convolvulaceae	*Convolvulus erubescens*	Pink Bindweed	Other (OG)															2
Convolvulaceae	*Dichondra repens*	Kidney Weed	Forb (FG)	0.1														
Cyperaceae	*Bolboschoenus fluviatilis*	Marsh Club-rush	Grass & grasslike (GG)											40			20	
Cyperaceae	*Carex appressa*	Tall Sedge	Grass & grasslike (GG)											4				
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	HTW			0.1	0.1				0.1			3		0.1		
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge	Grass & grasslike (GG)														2	
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant	HTW - Manageable							1		0.1						
Fabaceae	*Caesalpinia ferrea*	Brazilian Ironwood	Exotic					40										
Fabaceae	*Senna pendula var. glabrata*		Exotic		0.1													
Fabaceae	*Glycine tabacina*	Variable Glycine	Other (OG)	0.1														

Family	Scientific Name	Common Name	Form	% cover														
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Fabaceae	*Medicago polymorpha*	Burr Medic	Exotic			2										0.1		
Fabaceae	*Robinia pseudoacacia*	Black Locust	HTW							1								
Fabaceae	*Trifolium repens*	White Clover	Exotic			10	1	1			10					4		
Fabaceae	*Vicia sativa*	Common vetch	Exotic			0.1			0.1		0.1				0.1	0.1	0.1	
Fabaceae	*Acacia fimbriata*	Fringed Wattle	Shrub (SG)	4														
Fabaceae	*Acacia implexa*	Hickory Wattle	Shrub (SG)										1					
Fabaceae	*Acacia parramattensis*	Parramatta Wattle	Tree (TG)										2					
Fabaceae	*Acacia parramattensis*	Parramatta Wattle	Tree (TG)	2														
Haloragaceae	*Myriophyllum aquaticum*	Parrots Feather	Exotic											3				
Juglandaceae	*Carya illinoensis*	Pecan	Exotic													60		
Juncaceae	*Juncus continuus*		Grass & grasslike (GG)								0.1							
Juncaceae	*Juncus usitatus*		Grass & grasslike (GG)						2					10	0.1			0.1
Juncaginaceae	*Cycnogeton microtuberosum*		Exotic											0.1				
Lamiaceae	*Scutellaria racemosa*		Exotic				0.1											
Lamiaceae	*Stachys arvensis*	Stagger Weed	Exotic													0.1		
Lauraceae	*Cassytha glabella*		Other (OG)														0.1	
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush	Grass & grasslike (GG)		0.1										3			
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	Exotic	0.1		0.1		0.1			0.1	0.1		0.1	0.1	0.1		
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	Exotic	0.1			0.1			1	1		0.1	1	0.1			0.1
Meliaceae	*Melia azedarach*	White Cedar	Tree (TG)		8						0.1				0.1			
Moraceae	*Ficus coronata*	Creek Sandpaper Fig	Shrub (SG)									4						
Moraceae	*Morus alba*	White Mulberry	Exotic							5								
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	Tree (TG)		4							2						
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	Shrub (SG)									1						
Myrtaceae	*Corymbia maculata*	Spotted Gum	Tree (TG)							15								
Myrtaceae	*Eucalyptus moluccana*	Grey Box	Tree (TG)															
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum	Tree (TG)	15			60			15		35						
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	Tree (TG)	15	20													
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	Shrub (SG)											8				
Myrtaceae	*Melaleuca sieberi*	0	Shrub (SG)	8														
Myrtaceae	*Syzygium spp.*	0	Shrub (SG)							2								

Family	Scientific Name	Common Name	Form	% cover														
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant	HTW		2													
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet	HTW		20					50			80		0.1			1
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	HTW	0.1	50					5		5			0.1	0.1		
Oleaceae	*Olea europaea*	Common Olive	HTW - Manageable		2													
Onagraceae	*Ludwigia peploides subsp. montevidensis*	Water Primrose	Forb (FG)											0.1			10	
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	Exotic				0.1					0.1		0.1				
Oxalidaceae	*Oxalis perennans*	0	Forb (FG)			0.1			0.1							0.1		
Passifloraceae	*Passiflora suberosa*	Cork Passionfruit	HTW	0.1	5					1								
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree	Tree (TG)									0.1		0.1				
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	Exotic	0.1			0.1	0.1	0.1	0.1	5				0.1	3		0.1
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass	Grass & grasslike (GG)										0.1					
Poaceae	*Avena fatua*	Wild Oats	Exotic								5		0.1		20	1	4	
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	HTW	2			1		10						20			
Poaceae	*Briza minor*	Shivery Grass	Exotic			2			2									
Poaceae	*Bromus catharticus*	Praire Grass	Exotic	0.1		3	10	1		1	30	1		5	2	5		5
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	Exotic			60	5	5		5			5					1
Poaceae	*Chloris gayana*	Rhodes Grass	HTW	0.1								0.1						5
Poaceae	*Cynodon dactylon*	Common Couch	Grass & grasslike (GG)	80		5	60	20	5	2	5	3		1		5	2	8
Poaceae	*Digitaria eriantha*	Finger Panic Grass	Exotic												30			
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HTW	10		0.1	1	20		1		1	2	2			1	5
Poaceae	*Eragrostis curvula*	African Lovegrass	HTW	1			2		80	5	2		10		3			
Poaceae	*Lachnagrostis filiformis*		Grass & grasslike (GG)											0.1		1	0.1	
Poaceae	*Lolium perenne*	Perennial Ryegrass	Exotic				2		5	0.1	1			1	0.1	40		
Poaceae	*Panicum miliaceum*	French Millet	Exotic												30			1
Poaceae	*Panicum simile*	Two-colour Panic	Grass & grasslike (GG)												5			
Poaceae	*Panicum spp.*	Panicum	Grass & grasslike (GG)				0.1											2
Poaceae	*Paspalum dilatatum*	Paspalum	HTW						5							1		
Poaceae	*Paspalum urvillei*	Vasey Grass	Exotic								10	0.1			5			
Poaceae	*Phalaris aquatica*	Phalaris	Exotic														1	
Poaceae	*Poa annua*	Winter Grass	Exotic			0.1		3								0.1		

Family	Scientific Name	Common Name	Form	% cover														
				Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Poaceae	*Rostraria cristata*	Annual Cat's Tail	Exotic	2		0.1												
Poaceae	*Setaria parviflora*	0	Exotic									0.1						
Poaceae	*Sporobolus africanus*	Parramatta Grass	Exotic	0.1			1			0.1								
Polygonaceae	*Acetosa sagittata*	Rambling Dock	HTW									1					0.5	
Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	HTW				0.1											
Polygonaceae	*Persicaria decipiens*	Slender Knotweed	Forb (FG)											2			0.1	
Polygonaceae	*Persicaria lapathifolia*	Pale Knotweed	Forb (FG)														0.1	
Polygonaceae	*Rumex brownii*	Swamp Dock	Forb (FG)				0.1											
Polygonaceae	*Rumex crispus*	Curled Dock	Exotic							0.1	1	0.1		1		0.1		0.1
Primulaceae	*Lysimachia arvensis*	Scarlet Pimpernel	Exotic								0.1				0.1		0.1	
Proteaceae	*Grevillea robusta*	Silky Oak	Tree (TG)							10				20				
Ranunculaceae	*Clematis aristata*	Old Man's Beard	Other (OG)	0.1														
Ranunculaceae	*Ranunculus sceleratus*	Celery Buttercup	Exotic														3	
Rubiaceae	*Galium aparine*	Goosegrass	Exotic								0.1			0.1				0.1
Salicaceae	*Populus nigra*	Lombardy Poplar	Exotic							10			10		60			
Salicaceae	*Salix nigra*	Black Willow	Exotic											20				
Sapindaceae	*Acer negundo*	Box Elder	HTW - Manageable									8						
Sapindaceae	*Cardiospermum grandiflorum*	Balloon Vine	HTW									20	4					30
Solanaceae	*Cestrum parqui*	Green Cestrum	HTW							1		1						2
Solanaceae	*Solanum americanum*	Glossy Nightshade	Forb (FG)									0.1					0.1	
Solanaceae	*Solanum linnaeanum*	Apple of Sodom	Exotic									0.1						0.1
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	Exotic		0.1							0.1					0.1	1
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	Exotic	0.1								0.1			0.1			
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi	Grass & grasslike (GG)													1	3	
Ulmaceae	*Ulmus x hollandica*		Exotic							1	1	2		4		0.1	5	1
Verbenaceae	*Lantana camara*	Lantana	HTW - Manageable		10								3					
Verbenaceae	*Verbena bonariensis*	Purpletop	Exotic	0.1		0.1	0.1		0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	1

*Note: *Cover determined in accordance with the BAM.*

Table A2: Recorded fauna

Class	Scientific Name	Common Name	Native or Exotic	BC Act	EPBC Act
Amphibia	*Limnodynastes tasmaniensis*	Spotted Grass Frog	Native	P	-
Aves	*Gymnorhina tibicen*	Australian Magpie	Native	P	-
Aves	*Corvus coronoides*	Australian Raven	Native	P	-
Aves	*Manorina melanophrys*	Bell Miner	Native	P	-
Aves	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	Native	P	-
Aves	*Entomyzon cyanotis*	Blue-faced Honeyeater	Native	P	-
Aves	*Acridotheres tristis*	Common Myna	Exotic	-	-
Aves	*Sturnus vulgaris*	Common Starling	Exotic	-	-
Aves	*Psophodes olivaceus*	Eastern Whipbird	Native	P	-
Aves	*Eopsaltria australis*	Eastern Yellow Robin	Native	P	-
Aves	*Turdus merula*	Eurasian Blackbird	Exotic	-	-
Aves	*Eolophus roseicapilla*	Galah	Native	P	-
Aves	*Rhipidura albiscapa*	Grey Fantail	Native	P	-
Aves	*Cacatua sanguinea*	Little Corella	Native	P	-
Aves	*Cacatua tenuirostris*	Long-billed Corella	Native	P	-
Aves	*Grallina cyanoleuca*	Magpie-lark	Native	P	-
Aves	*Manorina melanocephala*	Noisy Miner	Native	P	-
Aves	*Cracticus nigrogularis*	Pied Butcherbird	Native	P	-
Aves	*Trichoglossus haematodus*	Rainbow Lorikeet	Native	P	-
Aves	*Myiagra inquieta*	Restless Flycatcher	Native	P	-
Aves	*Malurus cyaneus*	Superb Fairy-wren	Native	P	-
Aves	*Podargus strigoides*	Tawny Frogmouth	Native	P	-
Aves	*Hirundo neoxena*	Welcome Swallow	Native	P	-
Aves	*Sericornis frontalis*	White-browed Scrubwren	Native	P	-
Mammalia	*Rattus rattus*	Black Rat	Exotic	-	-
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	Native	P	-
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	Native	P	-
Mammalia	*Scotorepens orion*	Eastern Broad-nosed Bat	Native	P	-
Mammalia	*Vespadelus troughtoni*	Eastern Cave Bat	Native	V,P	-

Class	Scientific Name	Common Name	Native or Exotic	BC Act	EPBC Act
Mammalia	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	Native	V,P	-
Mammalia	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	Native	V,P	-
Mammalia	*Vespadelus pumilus*	Eastern Forest Bat	Native	P	-
Mammalia	*Ozimops ridei*	Eastern Free-tailed Bat	Native	P	-
Mammalia	*Chalinolobus gouldii*	Gould's Wattled Bat	Native	P	-
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	Native	V,P	-
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	Native	V,P	V
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Native	V,P	-
Mammalia	*Vespadelus vulturnus*	Little Forest Bat	Native	P	-
Mammalia	*Vespadelus regulus*	Southern Forest Bat	Native	P	-
Mammalia	*Myotis macropus*	Southern Myotis	Native	V,P	-
Mammalia	*Petaurus breviceps*	Sugar Glider	Native	P	-
Mammalia	*Austronomus australis*	White-striped Freetail-bat	Native	P	-
Gastropoda	*Austrorhytida capillacea*	Common Southern Carnivorous Snail	Native	-	-
Gastropoda	*Bradybaena similaris*	Asian tramp snail	Exotic	-	-

Appendix B: Habitat suitability assessment

Use the below criteria to determine the likelihood that a threatened species could occur in the study area. The criteria are designed for use in a BAR only and is not applicable for use in a BDAR (i.e., where the BAM-C is being used). Only recorded sightings from BioNet are valid for these criteria.

Table B1: Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey or has been recorded within the past five years (known from a reputable source).
High	A species is considered highly likely to occur in the study area if: • *There are previous credible records on BioNet within the study area from the last 10 years and suitable habitat is present.* **OR** • *The species is highly mobile, is dependent on identified suitable habitat within the study area (i.e., for breeding or important life cycle periods such as winter flowering resources) and has been recorded recently (within five years) on BioNet in the locality. This also includes species known or likely to visit the study area during regular seasonal movements or migration.*
Moderate	A species is considered moderately likely to occur in the study area if: • *Any suitable habitat (e.g., foraging) is present in the study area, the species is highly mobile and has been recorded in the locality in the last 10 years on BioNet. The species may be 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** • *The species is not highly mobile, is dependent on identified suitable habitat features (e.g., hollows, rocky outcrops) within the study area and has been recorded in the locality in the last 10 years on BioNet.* **OR** • *For flora species that are associated with PCTs in the study area (see TBDC) or have been recorded in the locality in the last 10 years on BioNet – the associated PCT/habitat present in the study area is not degraded and the species was not targeted by surveys in accordance with the BAM and relevant survey guidelines. In addition, for flora species known to occur in disturbed areas (e.g., orchids), records from any time within the locality may warrant inclusion in this category.*
Low	A species is considered to have a low likelihood of occurring in the study area if: • *For highly mobile species, the species may be an occasional visitor, but habitat similar to the study area is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on habitats in the study area and the species has not been recorded in the locality in the last 10 years on BioNet.* **OR** • *The species is not highly mobile, is dependent on identified suitable habitat features (e.g., hollows, rocky outcrops) within the study area and has not been recorded in the locality in the last 10 years on BioNet.* **OR**

Likelihood	Criteria
	• *For flora species that are associated with PCTs in the study area (see TBDC) and the species was not identified following targeted surveys in accordance with the BAM and relevant survey guidelines. Flora species that have been recorded in the locality on BioNet at any time, associated suitable habitat (see the TBDC) is not present in the study area, though similar habitats of the same vegetation formation is present in the study area.*
Unlikely	Suitable habitat for the species is absent from the study area.

Table B2: Habitat suitability assessment

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Flora							
Acacia bynoeana Bynoe's Wattle	E	V	166	BioNet PSMT	Sp.	Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches.	**Unlikely** – no potential habitat. All dry sclerophyll forest is CPW on clay soils.
Acacia flocktoniae Flockton Wattle	V	V	1	BioNet	Sp.	Grows in dry sclerophyll forest on sandstone.	**Unlikely** – no potential habitat. All dry sclerophyll forest is CPW on clay soils.
Acacia gordonii -	E	E	-	PMST	Sp.	Occurs in dry sclerophyll forest and heaths amongst or within rock platforms on sandstone outcrops.	**Unlikely** – no potential habitat. All dry sclerophyll forest is CPW on clay soils.
Acacia meiantha -	E	E	1	BioNet	Sp.	Straggling shrub to 1.5 m high, it is found in three disjunct populations, all within the Central Tablelands and within 10 kms of each other. These populations include Clarence, which covers an area of approximately 1 ha; Mullions Range, covering approximately 5 ha; and Aarons Pass, which is confined to 2.5 km of road easements.	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA SR.
Acacia pubescens Downy Wattle	V	V	6	BioNet PMST BAM-C	Sp.	The distribution of this species is concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. This species 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.	**Low** – proposal area contains potential habitat within CPW but there are no nearby records.
Acrophyllum australe -	V	V	-	PMST	Sp.	Damp crevices and rock faces, near waterfalls and drip zones, in moist clayey soils, with permanent moisture. Restricted to Wollemi IBRA subregion.	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA SR.
Allocasuarina glareicola -	E	E	115	BioNet PMST	Sp.	A smooth –barked, slender shrub to 2 m high. The species grows in Castlereagh woodland on tertiary, alluvial gravel with yellow clayey subsoil and lateritic soil.	**Unlikely** – no potential habitat. Castlereagh woodland is not present within the proposal area.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Asterolasia elegans -	E	E	-	PMST	Sp.	A tall, thin shrub to 3 m high distinguished by the rusty, star-shaped hairs on both leaf surfaces. Restricted to Pittwater and Yengo IBRA subregions. Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA, the species is known from seven known populations. Habitat for the species includes Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA SR.
Caladenia tessellata Thick Lip Spider Orchid	E	V	-	BAM-C	Sp.	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Generally found in grassy sclerophyll woodland on clay loam or sandy soils.	**Unlikely** – proposal area is outside of known distribution.
Cryptostylis hunteriana Leafless Tongue Orchid	V	V	-	PMST	Sp.	The species occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences for this species are not well defined, however it is known to grow in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with *Cryptostylis subulata* and *Cryptostylis erecta*. Within the Sydney Basin IBRA region, it is restricted to Ettrema, Hunter, Illawarra, Jervis, Moss Vale, Pittwater, Sydney Cataract and Wyong IBRA subregions.	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA SR.
Cynanchum elegans White-flowered Wax Plant	E	E	4	BioNet PMST	Sp.	The species occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. Habitat for the species includes Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	**Low** – Marginal habitat within CPW and RFEF. No nearby records.
Commersonia prostrata Dwarf Kerraweng	E	E	-	BAM-C	Sp.	Ground-hugging shrub that forms mats to more than 1 m across. Occurs on sandy, sometimes peaty soils in a wide variety of habitats. Distribution limits: Southern Highlands to North Coast (Tomago).	**Unlikely –** proposal area is outside of known distribution. Records within Cumberland IBRA subregion are restricted to the far southern portion near Couridja.
Deyeuxia appressa	E	E	-	BAM-C	Sp.	An erect perennial grass to 0.9 m high. A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. May now be extinct in the wild due to the level of habitat loss and development that has occurred.	**Unlikely –** proposal area is outside of distribution. Known occurrence is restricted to near Hornsby and Bankstown with no records from the Cumberland Plain itself.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Dillwynia tenuifolia	E,V	-	2770	BioNet BAM-C	Sp.	Low spreading pea-flower shrub to one metre high. The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. The species occurs in Castlereagh Ironbark Forest, Shale Gravel Transition Forest and Castlereagh Scribbly Gum Woodland on tertiary alluvium or laterised clays.	**Unlikely** – No suitable habitat. This species does not occur in CPW or RFEF.
Epacris sparsa Sparse Heath	V	V	15	BioNet PMST	Sp.	At the base of cliffs or rock faces, on rock ledges or among rocks in the riparian flood zone of the banks of the Lower Grose River between 2–10-m. Restricted to the Wollemi IBRA subregion.	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA SR.
Eucalyptus aggregata Black Gum	E,V	V	-	PMST	Sp.	Small to medium sized woodland tree growing to approx. 18m tall. Grows in the lowest part of the landscape on alluvial soils, poorly drained flats and adjacent to creeks and rivers. Commonly associated with other cold adapted eucalypts such as Snow Gum or White Sallee. It occurs in the Southeastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion (restricted to the Burragorang, Ettrema, Moss Vale and Wollemi subregions). Black Gum has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands, for example in the Blayney, Crookwell, Goulburn, Braidwood, and Bungendore districts	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA SR.
Eucalyptus benthamii Camden White Gum	E	V	4	BioNet BAM-C	Sp.	A tall tree with smooth, white bark and numerous flaky ribbons this species occurs on the alluvial flats of the Nepean River and its tributaries. The species requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment.	**Low** – marginal habitat within RFEF. No nearby records.
Eucalyptus glaucina Slaty Red Gum	V	V	-	BAM-C	Sp.	Gum to 30 m high. Grows in dry open forest and woodlands on clay soils. Distribution limits N-Tweed Heads S-Hunter Valley.	**Unlikely** – proposal area is outside of known distribution: no records from Cumberland Plain IBRA subregion
Eucalyptus sp. Cattai	E	CE	-	PMST	Sp.	Emergent tree in scrub, heath, and low woodland on sandy soils. The sites at which it occurs are generally flat and on ridge tops. Occurs in The Hills Local Government Area, with known populations occurring within the area bounded by Kellyville - Maraylya - Glenorie. Restricted to Yengo IBRA subregion.	**Unlikely** – proposal area is outside of known distribution which does not include the Cumberland IBRA subregion.
Genoplesium baueri Bauer's Midge Orchid	E	E	-	PMST	Sp.	Distribution of this species is generally within coastal areas from Ulladulla on the south coast to Port Stephens on the mid-north coast. Grows in dry sclerophyll forest and moss gardens over sandstone.	**Unlikely** – no suitable habitat as proposal area does not occur on sandstone substrate.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Grammitis stenophylla Narrow-leaf Finger Fern	E	-	5	BioNet	Sp.	Little fern, growing in small colonies, with hanging or erect fronds. Occurs in eastern Queensland and eastern NSW in moist places, on rocks in rainforest and in wet sclerophyll forest.	**Unlikely–** No suitable habitat.
Grevillea juniperina subsp. *juniperina* Juniper-leaved Grevillea	V	-	1108	BioNet BAM-C	Sp.	Broadly spreading to erect shrub 2.5 m tall. Grows in open dry sclerophyll (eucalypt-dominated) forest or woodland, at altitudes of less than about 50 m, in sandy to clay-loam soils and red pseudolateritic gravels. Endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town.	**Low –** potential but degraded habitat, no records within 2 km.
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	V	V	6	BioNet	Sp.	The species distribution is between Moss Vale/Bargo and the lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. The habitat for the species is broad including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks. In the Sydney region it occurs in Shale Sandstone Transition Forest.	**Unlikely** – unsuitable habitat within proposal area. Occurs within Shale Sandstone Transition Forest which is not present.
Haloragis exalata subsp. *exalata* Square Raspwort	V	V	-	PMST	Sp.	A robust, perennial herb distributed from as far north as Narrabri and south to the Glenelg River in Victoria. Occurs on edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100 m.	**Low** – marginal vegetation along river and wetlands within PCTs 4025 and 3975. No nearby records.
Haloragodendron lucasii	E	E	-	PMST	Sp.	An erect hairless shrub to 1.5 m tall, with four-winged branches arising in pairs. The known locations of this species are confined to a very narrow distribution on the north shore of Sydney. The species is associated with dry sclerophyll forest.	**Unlikely** – Proposal area is outside species' distribution. Within the Cumberland IBRA SR, this species is restricted to the Hornsby and Ku-Ring-gai LGAs.
Hibbertia acaulothrix	-	E	-	PMST	Sp.	Although listed as endangered there are no records of the species occurring in NSW. Erect shrub up to 1.1m tall occurring on sedimentary rocks, recorded growing in Eucalyptus sieberi woodland or associated with Allocasuarina littoralis, Corymbia gummifera, Leptospermum trinervium. Known from several widely separated localities in New South Wales, from Wadbilliga National Park in the Southern Tablelands, through the Nattai-Wollondilly area in the southern Central Tablelands.	**Unlikely** – proposal area is outside of species distribution.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Hibbertia cistiflora subsp. *quadristaminea*	-	E	-	PMST	Sp.	Small shrub growing to 0.3 m in height, with erect-spreading to decumbent branches up to 0.4 m long. Kown from two localities from the Blue Mountains National Park and Newnes State Forest in heath on sandstone.	**Unlikely** – species is restricted to the Blue Mountains region so proposal area is outside distribution.
Hibbertia fumana	CE	-	33	BioNet	Sp.	Decumbent shrub/sub-shrub, prostrate to weakly ascending up to 20 cm tall. Occurs in a long intergrade between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest; also found associated with aeolian (wind) sand deposits. Species has been found to occur in a variety of structural habitats including open areas, disturbed sites and within thick ground cover dominated by a heavy cover of sedges, rushes and grasses. Currently known from 2 populations in Moorebank and Bankstown in western Sydney.	**Unlikely** – no suitable habitat within the proposal area. Does not occur in CPW, RFEF or freshwater wetlands.
Hibbertia puberula	E	-	-	BAM-C	Sp.	Shrublets with branches up to 30 cm long. It favours dry sclerophyll woodland or low heath on sandy soils or rarely in clay, with or without rocks underneath. It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records are from Hawkesbury River area in Sydney and the Blue Mountains.	**Low** – marginal habitat. No nearby records.
Hibbertia sp. Bankstown	E	CE	102	BioNet BAM-C	Sp.	Prostrate shrub with spreading, hairless, wiry branches up to 4 cm in length. Currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs	**Unlikely** – proposal area is outside distribution of the species (Bankstown Airport).
Homoranthus darwinioides Fairy Bells	V	V	-	PMST	Sp.	Rare in the central tablelands and western slopes of NSW, occurring from Putty to the Dubbo district. It is found west of Muswellbrook between Merriwa and Bylong, and north of Muswellbrook to Goonoo SCA. The species has been collected from Lee's Pinch, but not relocated at its original locality north of Mt Coricudgy above the headwaters of Widden Brook. Grows in in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand.	**Unlikely** – proposal area is outside the distribution of the species: it does not occur within the Cumberland IBRA subregion.
Kunzea rupestris	V	V	-	PMST	Sp.	A clonal shrub to about 1.5 m high. Restricted, with most locations in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park, all within the Central Coast botanical subdivision	**Unlikely** – no suitable habitat (shallow depressions on sandstone); does not occur within the Cumberland IBRA subregion.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						of NSW. The species grows in shallow depressions on large flat sandstone rock outcrops.	
Lasiopetalum joyceae	V	V	-	PMST	Sp.	An erect shrub to 2 m tall with leaves that are linear, 3 - 9 cm long, mostly 3 - 6 mm wide, with revolute margins. Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. Grows in heath on sandstone.	**Unlikely** – no suitable habitat (heath on sandstone); does not occur within the Cumberland IBRA subregion.
Leucopogon exolasius Woronora Beard-heath	V	V	1	BioNet PMST	Sp.	Erect shrub with hanging tubular flowers. The species occurs along the upper Georges River area and in Heathcote National Park where it occupies rocky hillsides in woodland on sandstone.	**Unlikely** – no suitable habitat (woodland on sandstone)
Leucopogon fletcheri subsp. *fletcheri*	E	-	457	BioNet	Sp.	Erect shrub with pungent leaves and pendant-like white flowers. The species occurs in dry eucalypt woodland or in shrub land on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. TBDC habitat constraints are slopes nearby rocky areas; and weathered laterite over sandstone, on sandstone ridges and outcrops.	**Unlikely** – habitat constraints are absent.
Marsdenia viridiflora subsp. *viridiflora* Endangered population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs	E Pop.	-	2	BioNet	Sp.	Climber with twinning stems, occurring in vine thickets and open shale woodland. Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range.	**Unlikely** – proposal area is within Hawkesbury LGA.
Maundia triglochinoides	V	-	-	BAM-C	Sp.	A reed-like herb which grows in swamps and shallow fresh water on clay. Distribution Limits N-Qld border S-Wyong.	**Unlikely** – does not occur within the Cumberland IBRA subregion.
Melaleuca deanei Deane's Paperbark	V	V	-	PMST	Sp.	Deane's Paperbark is a shrub to 3 m high with fibrous, flaky bark. The species occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. Habitat for the species is primarily ridgetop woodland, with only 5% of sites in heath on sandstone.	**Unlikely** – no suitable habitat within the proposal area (ridgetop woodland & heath).
Micromyrtus blakelyi	V	V	-	PMST	Sp.	Low spreading erect shrub 30–60 cm tall with small flowers fringe with hairs and tinged pink. Typically occurs within heathlands in shallow sandy soil in cracks and depressions of sandstone rock platforms. Restricted to areas near the Hawkesbury River, north of Sydney.	**Unlikely** – no suitable habitat (heath on sandstone); does not occur within the Cumberland IBRA subregion.
Micromyrtus minutiflora	E	V	502	BioNet PMST	Sp.	Slender spreading shrub to 2 m high, restricted to the general area between Richmond and Penrith, western Sydney. Grows in Castlereagh	**Unlikely** – no suitable habitat (Castlereagh Scribbly Gum Woodland,

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
				BAM-C		Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	Ironbark Forest, Shale/Gravel Transition Forest) or geology (tertiary alluvium).
Olearia cordata	V	V	-	PMST	Sp.	A slender shrub up to 2 m tall endemic to NSW with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.	**Unlikely** – no suitable habitat (forest / shrubland on sandstone ridges).
Persicaria elatior Tall Knotweed	V	V	-	PMST	Sp.	Grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	**Low** – marginal habitat fringing wetlands but no nearby records.
Persoonia acerosa Needle Geebung	V	V	-	PMST	Sp.	Small erect to spreading shrub up to 1-2m tall occurring in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils. It has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct.	**Unlikely** – species does not occur within Cumberland IBRA subregion.
Persoonia hirsuta Hairy Geebung	E	E	7	BioNet PMST	Sp.	A spreading decumbent shrub 0.3-1.5m tall, densely hairy and occurring n clayey and sandy soils in dry sclerophyll open forest, woodland and heath, primarily on the Mittagong Formation and on the upper Hawkesbury Sandstone. The species is distributed from Singleton in the north, along the east coast to Hilltop in the south west, Dombarton in the south east and the Blue Mountains to the west.	**Low** – marginal habitat within CPW and RFEF, no nearby records.
Persoonia nutans Nodding Geebung	E	E	1842	BioNet PMST	Sp.	Spreading to erect shrub 0.5–2.5 m tall, restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Occurs within Agnes Banks Woodland, Castlereagh Scribbly Gum Woodland and Cooks River / Castlereagh Ironbark Forests.	**Unlikely** – no suitable habitat on proposal area.
Pimelea curviflora var. *curviflora*	V	V	19	BioNet PMST	Sp.	An erect, open shrub generally growing to 4 cm high, but sometimes up to 5- cm high. The species is confined to the coastal area of the Sydney and Illawarra regions of NSW occurring on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands..	**Unlikely** – no suitable habitat on proposal area.
Pimelea spicata Spiked Rice-flower	E	E	8	BioNet PMST	Sp.	Small shrub up to 50 cm tall occurring in Cumberland Plain and Illawarra. This species is found on well-structured clay soils in association with Grey Box communities and in areas of ironbark. Co-occurring species in the Cumberland Plain sites are grey box (*Eucalyptus*	**Low** – marginal habitat and old records (1909) nearby.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						moluccana), forest red gum (*E. tereticornis*) and narrow-leaved ironbark (*E. crebra*).	
Pomaderris brunnea Brown Pomaderris	E	V	-	PMST	Sp.	Shrub growing up to 3 m tall with distinctly hairy stems. The species occurs in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. Habitat for this species includes moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	**Unlikely** – proposal area is outside the distribution of this species.
Pterostylis gibbosa Illawarra Greenhood	E	E	-	PMST	Sp.	This species of ground-dwelling orchid is known from a small number of populations in the Hunter region, the Illawarra region, and the Shoalhaven region in New South Wales. Habitat for this species includes open forest and woodland on flat or gently sloping land.	**Unlikely** – species does not occur within Cumberland IBRA subregion.
Pterostylis saxicola Sydney Plains Greenhood	E	E	5	BioNet	Sp.	A ground orchid with reddish brown and green translucent flowers on a slender stem to 35 cm tall. The species is restricted to western Sydney between Freemans Reach in the north and Picton in the south. Occurs within an ecological gradient from clay soils derived from Ashfield Shale to thin accumulations of humus rich sandy soils on Hawkesbury Sandstone sheets and rock shelves. Commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.	**Low** – very marginal habitat within CPW. No nearby records.
Pultenaea glabra Smooth Bush-Pea	V	V	-	PMST	Sp.	In NSW restricted to higher Blue Mountains in the Katoomba-Hazelbrook and Mt Victoria areas. Unconfirmed sightings in Mt Wilson and Mt Irvine areas. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.	**Unlikely** – Does not occur within the Cumberland IBRA subregion.
Pultenaea parviflora	E	V	104	BioNet PMST	Sp.	Scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and areas transitioning to Castlereagh Scribbly Gum Woodland.	**Unlikely** – no suitable habitat within proposal area.
Pultenaea pedunculata	E	-	-	BAM-C	Sp.	NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. In the Cumberland Plain the species favours sites in clay or sandy-clay soils (Blacktown Soil Landscape) on Wianamatta Shale-derived soils, usually close to patches of Tertiary Alluvium (Liverpool area) or at or near the Shale-Sandstone interface (Appin). All sites have a lateritic influence with ironstone gravel (nodules) present.	**Unlikely** – habitat absent, no lateritic influence.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Pultenaea villifera Endangered population in the Blue Mountains LGA	E Pop.	-	10	BioNet	Sp.	Spreading to erect shrub up to 1 m tall with moderately hairy stems. Grows in dry sclerophyll forest on sandy soil with Has a patchy distribution within NSW, occurring within the South and Central Coasts and Southern Tablelands. The population of *P. villifera* in the Blue Mountains Local Government Area is disjunct from other known populations.	**Unlikely** – population is restricted to the Blue Mountains LGA.
Rhizanthella slateri Eastern Australian underground orchid	V	E	-	PMST	Sp.	The species grows in eucalypt forest but no informative data on the likely preferred habitat for the species is available. Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	**Unlikely** – habitat is highly disturbed and unlikely to support this species. There are no records of this species within the Cumberland IBRA subregion.
Rhodamnia rubescens Scrub Turpentine	CE	CE	18	BioNet PMST	Sp.	Small shrub to tree up to 25m tall occurring in coastal districts north from Batemans Bay in NSW to areas of inland Bundaberg, QLD. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	**Unlikely** – no suitable habitat within proposal area.
Syzygium paniculatum Magenta Lilly Pilly	E	V	4	BioNet PMST	Sp.	The species occurs in a narrow coastal strip from Bulahdelah to Conjola State Forest. Rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests Plants produce white flower-clusters at the end of each branch is the preferred habitat for this species. The petals are small accompanied by prominent long stamens.	**Unlikely** – no suitable habitat within proposal area.
Tetratheca glandulosa	V	-	9	BioNet	Sp.	Small, spreading shrub which grows to a height between 2- and 5- cm. The five to 10 mm long leaves are one mm wide, opposite with recurved margins. Dark, red tipped hairs cover the flower stalk and sepals. The four flower petals can be dark to pale pink. Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches..	**Unlikely** – no suitable habitat within proposal area.
Thelymitra kangaloonica Kangaloon Sun Orchid	E	CE	-	PMST	Sp.	The species is a terrestrial orchid, with a green or purplish flower stem growing 2–56 cm high. The Kangaloon Sun-orchid is endemic to the Central Coast/Tablelands of NSW growing in seasonally swampy sedgeland and on grey silty soil.	**Unlikely** – Does not occur within the Cumberland IBRA subregion.
Thesium australe Austral Toadflax	V	V	-	PMST	Sp.	The species occurs in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands.	**Unlikely** – very marginal habitat within CPW. No nearby records. One record within entire Cumberland IBRA

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						Habitat for this species includes grassland on coastal headlands or grassland and grassy woodland away from the coast.	subregion from 1803, with no records since. Is considered to be extinct on the Cumberland Plain.
Velleia perfoliata	V	V	-	PMST	Sp.	Glaucous perennial herb up to 50 cm tall. Grows in heath on shallow sandy soils over sandstone, only known from the Hawkesbury district and upper Hunter Valley.	**Unlikely** – Does not occur within the Cumberland IBRA subregion. No habitat within proposal area.
Zieria involucrata	E	V	2	BioNet PMST	Sp.	An erect sparse shrub growing up to 2 m tall primarily occurring in wet sclerophyll forest, in sheltered forests on mid- to lower slopes and valleys. Has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains local government areas.	**Unlikely** – Does not occur within the Cumberland IBRA subregion. No habitat within proposal area.
Aves							
Anthochaera phrygia Regent Honeyeater	E	CE	19	BioNet PMST BAM-C	Dual	In NSW the species is confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Habitat for the species includes dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	**Moderate** – no mapped important habitat within proposal area, but suitable foraging habitat within proposal area (PCT 3320, PCT 4025, PNV). Nearby recent records in Richmond and North Richmond.
Artamus cyanopterus cyanopterus Dusky Woodswallow	V	-	78	BioNet BAM-C	Eco.	Found 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. Prefers habitat with an open understorey. Often observed in farmland tree patches or roadside remnants.	**Moderate** – suitable foraging habitat within proposal area (PCT 3320, PCT 4025, PNV). Nearby recent records in North Richmond.
Botaurus poiciloptilus Australasian Bittern	E	E	8	BioNet PMST BAM-C	Eco.	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands.	**Low** – suitable foraging habitat within proposal area (wetlands). Nearby record from Pughs Lagoon in 1991.
Burhinus grallarius Bush Stone-curlew	E	-	6	BioNet BAM-C	Sp.	Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory.	**Low** – marginal habitat within proposal area. Nearby old records (1980s).

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Calidris ferruginea Curlew Sandpiper	E	CE,M	11	BioNet PMST BAM-C	Dual	The species occurs along the entire coast of NSW, particularly in the Hunter Estuary, and freshwater wetlands in the Murray-Darling Basin. Breeds in Siberia and migrates to Australia (as well as Africa and Asia) for the non-breeding period, arriving between August and November, and departing between March and mid-April. It generally occupies littoral and estuarine habitats, and in New South Wales can be found mainly in intertidal mudflats of sheltered coasts.	**Low** – marginal foraging habitat within proposal area. No mapped important habitat for species breeding credits. Nearby old records (1980s).
Callocephalon fimbriatum Gang-gang Cockatoo	V	E	48	BioNet PMST BAM-C	Dual	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (*Eucalyptus pauciflora*) woodland and occasionally in temperate rainforests.	**Low** – potential low-value foraging habitat only. Location is not suitable for breeding, which occurs at higher altitudes. BioNet record from Grose Vale in 1996.
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo	V	V	42	BioNet PMST BAM-C	Dual	A small brown – black cockatoo with a large bill, short crest, and a coloured tail panel. Males typically have red tail panels and females have yellow to orange. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species) therefore inhabiting open forests and woodlands. The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina.	**Low** – nearby records from 2000s. Suitable foraging habitat along riverbank and planted *Casuarina*. No evidence of breeding in recorded hollows.
Chthonicola sagittata Speckled Warbler	V	-	14	BioNet BAM-C	Eco.	Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. The species inhabits a wide range of Eucalypt-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of low dense plants.	**Low** – suitable foraging habitat. Closest records are from 2000s and 90s.
Circus assimilis Spotted Harrier	V	-	9	BioNet BAM-C	Eco.	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	**Low** – Suitable foraging habitat. Closest records are from 80s and 00s.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	V	-	11	BioNet PMST BAM-C	Eco.	Small grey-brown bird with black streaking on the lower breast/belly and black bars on the undertail. Inhabits Box-Gum woodlands and dry open forest of inland slopes and plains. Preferred woodlands dominant by stringybarks or other rough-barked eucalypts. Forages in trees and on the ground. Endemic to eastern Australia, occurring from the coast to inland plains and western slopes of the great dividing range. Nests in tree or stump hollows greater than 6cm.	**Low** – suitable foraging habitat. No nearby records. Closest records from Windsor Downs NR from 2020.
Daphoenositta chrysoptera Varied Sittella	V	-	93	BioNet BAM-C	Eco.	Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	**Moderate** – suitable foraging habitat within proposal area (PCT 3320, PCT 4025, PNV). Nearby record in south of Hannah Park.
Ephippiorhynchus asiaticus Black-necked Stork	E	-	2	BioNet BAM-C	Eco.	Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. This species breeds during summer, nesting in or near a freshwater swamp.	**Low** – foraging habitat within wetlands. No nearby records. Closest record from Clarendon in 1976.
Epthianura albifrons White-fronted Chat	E	-	3	BioNet BAM-C	Eco.	Small passerine bird 12cm in length, with a short slender bill, square tipped tail, and rounded wings. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Two isolated sub-populations of are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve and one at Towra Point Nature Reserve.	**Low** – marginal foraging habitat. Records from Richmond and North Richmon from 1965.
Erythrotriorchis radiatus Red Goshawk	E	V	-	PMST	Sp.	Inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed	**Unlikely** – proposal area is outside the distribution of this species.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers. Southern limits are Northern Rivers of NSW.	
Falco hypoleucos Grey Falcon	V	V	-	PMST	Eco.	Medium-sized, compact, pale falcon with a heavy, thick-set, deep-chested appearance. The species is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	**Unlikely** – proposal area is outside the distribution of this species.
Falco subniger Black Falcon	V	-	8	BioNet BAM-C	Eco.	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. 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 over hundreds of kilometres. The Black Falcon inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees.	**Low** – suitable foraging habitat. Nearby record from Pughs Lagoon from 2000.
Glossopsitta pusilla Little Lorikeet	V	-	60	BioNet BAM-C	Eco.	The species occurs from the coast to western slopes of the Great Dividing Range and inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands *Eucalyptus albens* and *E. melliodora* are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3 cm) hollows in living, smooth-barked eucalypts, especially *Eucalyptus viminalis, E. blakelyi* and *E. dealbata*. Most breeding records are from the western slopes.	**Moderate** – Suitable foraging and breeding habitat provided by remnant and planted Eucalypts (PCT 3320, PCT 4025, PNV). Nearby recent records.
Grantiella picta Painted Honeyeater	V	V	2	BioNet PMST	Eco.	The species is nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Habitat for the species includes Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests.	**Low** – suitable foraging habitat. No nearby or recent records.
Haliaeetus leucogaster White-bellied Sea-Eagle	V	-	65	BioNet BAM-C	Dual	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Feed mainly on fish and freshwater turtles, but also waterbirds,	**Low** – suitable foraging habitat and potential nest trees but no stick nests observed during survey. No nearby or recent records.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						reptiles, mammals and carrion. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass.	
Hieraaetus morphnoides Little Eagle	V	-	17	BioNet BAM-C	Dual	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies 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.	**Low** – suitable foraging habitat and potential nest trees but no stick nests observed during survey. No nearby or recent records.
Hirundapus caudacutus White-throated Needletail	P	V,M	19	BioNet PMST BAM-C	Eco.	Hunts insects whilst flying, using airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies often forage along favoured hilltops and timbered ranges. Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.	**Low** –suitable aerial foraging above proposal area. No nearby or recent records.
Irediparra gallinacea Comb-crested Jacana	V	-	8	BioNet BAM-C	Eco.	Occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW. Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation.	**Low** – marginal habitat within wetlands. No nearby or recent records.
Ixobrychus flavicollis Black Bittern	V	-	2	BioNet BAM-C	Eco.	This species is a heron, black in colour with distinct yellow streaks down the head and neck. Distribution: southern NSW to Cape York. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	**Low** – suitable habitat within wetlands and riverside. No nearby or recent records.
Lathamus discolor Swift Parrot	E	CE	40	BioNet PMST BAM-C	Dual	A migratory species that travels to the mainland from February to October, the species breeds in Tasmania from September to January. Principal over-winter habitat is box-ironbark communities on the inland	**High** – suitable winter foraging habitat: flowering *E. tereticornis,* and may feed on lerps on Eucalypts, particularly *E. moluccana* (PCT 3320, PCT 4025, PNV). Mapped important habitat only

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						slopes and plains. *Eucalyptus robusta, Corymbia maculata* and *C. gummifera* dominated coastal forests are also important habitat.	includes PCT 4025. Recent records within proposal area and close by. Mapped important habitat along riverbank.
Limosa lapponica baueri Bar-tailed Godwit	-	V	-	PMST	Dual	This species is a large migratory shorebird that visits Australia and NZ in the non-breeding season. It is typically recorded along coastlines of northern and eastern Australia. It occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons, and bays.	**Unlikely** – no suitable habitat.
Limosa limosa Black-tailed Godwit	V	M	4	BioNet BAM-C	Dual	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	**Low** – marginal habitat within wetlands and wet fields. No nearby recent records.
Lophoictinia isura Square-tailed Kite	V	-	36	BioNet BAM-C	Dual	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Breeding is from July to February.	**Moderate** – suitable foraging habitat and potential nest trees but no stick nests observed during survey. Nearby recent records.
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	V	-	-	PMST	Eco.	Widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. The south-eastern form (subspecies cucullata) is found from Brisbane to Adelaide and throughout much of inland NSW. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	**Low** – suitable foraging habitat. No nearby or recent records.
Melithreptus gularis gularis	V	-	6	BioNet BAM-C	Eco.	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting	**Low** – suitable foraging habitat. No nearby or recent records.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Black-chinned Honeyeater (eastern subspecies)						habitat) and tea-trees. Breeds solitarily or co-operatively, with up to five or six adults, from June to December.	
Neophema chrysostoma Blue-winged Parrot	V	V	-	PMST	Recently listed – credit class not assigned	This species is a slender parrot up to 24cm in length that gets its name from large, dark blue patches on the wing. Birds are recorded from northern Victoria, eastern South Australia, south-western Queensland and western New South Wales, with some birds reaching south-eastern New South Wales and eastern Victoria. Blue-winged parrots inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands.	**Unlikely** – no suitable habitat. Proposal area is outside species' distribution.
Neophema pulchella Turquoise Parrot	V	-	8	BioNet BAM-C	Eco.	Inhabits fringes of eucalypt woodlands, often adjacent to clearings, ridges and farmland creeks. Typically forages on the ground under trees. Distributed from southern Queensland to northern Victoria, extending from the coast to the western slopes of the Great Dividing Range. Nesting occurs from December to August in tree hollows.	**Low** – Suitable foraging and breeding habitat. No nearby records.
Ninox connivens Barking Owl	V	-	5	BioNet BAM-C	Dual	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in *Acacia* and *Casuarina*), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including *Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos* and *Eucalyptus blakelyi*. Birds and mammals important prey during breeding. Territories range from 3–2 ha.	**Low** – suitable foraging habitat, no suitable hollows for breeding. Nearby records but none recent.
Ninox strenua Powerful Owl	V	-	27	BioNet BAM-C	Dual	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. Breeding requires large tree hollows >20 cm diameter. Distribution limits: N-Border Ranges National Park. S-Eden	**Moderate** – suitable foraging habitat, no suitable hollows for breeding. Nearby recent records.
Numenius madagascariensis Eastern Curlew	-	CE,M	-	PMST	Dual	The eastern curlew is Australia's largest shorebird and a long-haul flyer. It is easily recognisable, with its long, down-curved bill. The species takes an annual migratory flight to Russia and northeastern China to breed, returning to Australia in August.	**Unlikely** – no suitable habitat. No mapped important habitat.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Onychoprion fuscata Sooty Tern	V	-	1	BioNet	Sp.	Found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters.	**Unlikely** – no suitable habitat.
Oxyura australis Blue-billed Duck	V	-	2	BioNet BAM-C	Eco.	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer.	**Moderate** – suitable habitat within wetlands (PCT 3975). Nearby and recent record from Pughs Lagoon.
Pachycephala olivacea Olive Whistler	V	-	3	BioNet	Eco.	Tall wet forest, woodlands and alpine heaths above 500 m altitude. Distributional limit: N-N-Border Ranges National Park. S-South of Eden.	**Unlikely** – no suitable habitat.
Pandion cristatus Eastern Osprey	V	-	1	BioNet BAM-C	Dual	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	**Low** – suitable foraging habitat and potential nest trees but no stick nests observed during survey. No nearby recent records.
Petroica boodang Scarlet Robin	V	-	24	BioNet BAM-C	Eco.	Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Habitat usually contains abundant logs and fallen timber: these are important components of its habitat. Mainly breed between the months of July and January.	**Low** – Suitable foraging and breeding habitat. No nearby recent records.
Petroica phoenicea Flame Robin	V	-	27	BioNet BAM-C		Prefers clearings or areas with open understoreys. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees.	**Low** – Suitable foraging and breeding habitat. No nearby recent records.
Petroica rodinogaster Pink Robin	V	-	2	BioNet	Eco.	Deep gullies in dense shrub layers of damp and wet forests or rainforests; more open areas during summer.	**Low** – Suitable foraging and breeding habitat. No nearby recent records.
Pycnoptilus floccosus Pilotbird	-	V	1	BioNet PMST	n/a	Pilotbirds are small, plump, ground-dwelling birds. Upland Pilotbirds occur above 600 m in the Brindabella Ranges in the Australian Capital Territory, and in the Snowy Mountains in New South Wales and north-east Vic. Lowland Pilotbirds occur in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia, to Dandenong near Melbourne.	**Unlikely** – no suitable habitat.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Rostratula australis Australian Painted Snipe	E	E	5	BioNet PMST BAM-C	Eco.	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. The species nests on the ground amongst tall reed-like vegetation near water. Habitat for the species includes the fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	**Low** – Marginal foraging habitat in wetlands. No nearby recent records.
Stagonopleura guttata Diamond Firetail	V	-	-	PMST BAM-C	Eco.	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Groups separate into small colonies to breed, between August and January.	**Low** – Suitable foraging and breeding habitat. No nearby recent records.
Stictonetta naevosa Freckled Duck	V	-	6	BioNet BAM-C	Eco.	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Nesting usually occurs between October and December but can take place at other times when conditions are favourable.	**Moderate** – Suitable habitat within wetlands (PCT 3975). Nearby recent records from Pughs Lagoon.
Tyto novaehollandiae Masked Owl	V	-	3	BioNet BAM-C	Dual	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 110- m. Roosts and breeds in large (>4-cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range 5–10 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	**Low** – suitable foraging habitat, no suitable breeding hollows. No nearby recent records.
Tyto tenebricosa Sooty Owl	V	-	1	BioNet BAM-C	Dual	Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>4-cm wide, 10-cm deep) tree hollows in unlogged/unburnt gullies within 10-m of streams or in caves.	**Low** – Suitable foraging and breeding habitat, no suitable breeding hollows. No nearby recent records.
Mammalia							
Cercartetus nanus Eastern Pygmy-possum	V	-	4	BioNet BAM-C	Sp.	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts	**Low** – marginal habitat within remnant CPW and RFEF. No nearby recent records.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						and bottlebrushes. Nests in banksias and myrtaceous shrubs. Distribution limit: N-Tweed Heads. S-Eden.	
Chalinolobus dwyeri Large-eared Pied Bat	V	V	8	BioNet PMST BAM-C	Sp.	The species occurs from the coast to the western slopes of the divide. The largest numbers of records are from sandstone escarpment country in the Sydney Basin and Hunter Valley. The species roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	**Moderate** – No suitable breeding habitat – site is more than 2 km from rocky areas containing caves, overhangs, escarpments, outcrops or crevices. Recorded culverts do not provide suitable roosting or breeding habitat. Nearby and recent records.
Dasyurus maculatus Spotted-tailed Quoll	V	E	21	BioNet PMST BAM-C	Eco.	Found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania the species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline	**Low** – Suitable habitat. No nearby records.
Falsistrellus tasmaniensis Eastern False Pipistrelle	V	-	19	BioNet BAM-C	Eco.	The species occurs on southeast coast and ranges. Prefers tall (>2-m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts include hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12 km foraging movements recorded). Hibernates in winter. Females are pregnant in late spring to early summer.	**Moderate** – suitable foraging and roosting habitat. Nearby and recent records.
Micronomus norfolkensis Eastern Coastal Free-tailed Bat	V	-	57	BioNet BAM-C	Eco.	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. Distribution limit: N-Woodenbong. S-Pambula.	**High** – Recorded within proposal area during survey. Proposal area provides suitable foraging, roosting and breeding habitat. Culverts do not provide potential roosting or breeding habitat.
Miniopterus australis Little Bent-winged Bat	V	-	12	BioNet BAM-C	Sp.	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. Distribution limit: N-Border Ranges National Park. S-Sydney.	**Moderate** – suitable foraging and roosting habitat. Culverts do not provide potential roosting or breeding habitat. Nearby and recent records.
Miniopterus orianae oceanensis Large Bent-winged Bat	V	-	50	BioNet BAM-C	Sp.	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. Distribution limit: N-Border Ranges National Park. S-South of Eden.	**High** – suitable foraging and roosting habitat. Culverts do not provide

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
							potential roosting or breeding habitat. Species recorded within proposal area.
Myotis macropus Southern Myotis	V	-	34	BioNet BAM-C	Sp.	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water and is dependent on waterways with pools of 3 m wide or greater for foraging. Habitat surrounding waterways is used for breeding and roosting. Breeds Nov-Dec. Distribution limit: N-Border Ranges National Park. S-South of Eden.	**High** – Species recorded within proposal area. Suitable foraging habitat over waterbodies. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat.
Notamacropus parma Parma Wallaby	V	V	-	PMST	Sp.	Inhabits rainforests and wet and dry sclerophyll forests with a dense understorey and associated grassy patches. Distribution limit: N-Border Ranges National Park. S-Morton National Park.	**Unlikely** – no suitable habitat.
Petauroides volans Southern Greater Glider	E	E	1	BioNet PMST BAM-C	Sp.	The species occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria. Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Occupy a relatively small home range with an average size of 1 to 3 ha .	**Unlikely** – no suitable habitat.
Petaurus australis Yellow-bellied Glider population on the Bago Plateau	E	V	27	BioNet PMST BAM-C	Eco.	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. Very mobile species known to occupy large home ranges between 2- to 85 ha.	**Low** – marginal habitat. No nearby or recent records.
Petaurus norfolcensis Squirrel Glider	V	-	18	BioNet BAM-C	Sp.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* midstorey.	**Moderate** – suitable habitat (PCT 3320, PCT 4025, PNV). Closest records 3 km W with narrow connective vegetation to north of the proposal area.
Petrogale penicillata Brush-tailed Rock-wallaby	E	V	1	BioNet PMST	Sp.	Occurring from Shoalhaven to the Queensland border the species is now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. The species inhabits rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	**Unlikely** – no suitable habitat.
Phascogale tapoatafa Brush-tailed Phascogale	V	-	1	BioNet	Sp.	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Mating occurs May – July.	**Low** – suitable habitat. No nearby or recent records.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
Phascolarctos cinereus Koala	E	E	318	BioNet PMST BAM-C	Sp.	Fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests containing suitable feed trees.	**Moderate** – suitable habitat (PCT 3320, PCT 4025). Records from 2 km away.
Pseudomys novaehollandiae New Holland Mouse	-	V	-	PMST	n/a	The species occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW it inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes. Species presence is strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath.	**Low** – very marginal habitat and no nearby records.
Pteropus poliocephalus Grey-headed Flying-fox	V	V	117	BioNet PMST BAM-C	Sp.	Generally this species is found within 2-- km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. Inhabit 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 2- km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	**High** – recorded foraging within proposal area and flying over. Suitable foraging habitat (PCT 3320, PCT 4025, PNV). Close and recent records but no breeding camps within proposal area or nearby.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	V	-	6	BioNet BAM-C	Eco.	Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Breeding has been recorded from December to mid-March. Seasonal movements are unknown.	**Moderate** – suitable foraging, roosting and breeding habitat. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat. Nearby recent records.
Scoteanax rueppellii Greater Broad-nosed Bat	V	-	24	BioNet BAM-C	Eco.	The species is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks.	**High** – Species recorded. Suitable foraging, roosting and breeding habitat. Potential roosting and breeding habitat in tree hollows. Culverts do not provide potential roosting or breeding habitat.
Vespadelus troughtoni Eastern Cave Bat	V	-	1	BioNet	Sp.	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW,	**Unlikely** – not known to occur within the Cumberland IBRA subregion.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds."	
Gastropoda							
Meridolum corneovirens Cumberland Plain Land Snail	E	-	109	BioNet BAM-C	Sp.	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris.	**Moderate** – marginal habitat within CPW and RFEF. Vegetation is highly modified with understorey dominated by exotic species. Recent records 2 km S & N.
Pommerhelix duralensis Dural Land Snail	E	E	10	BioNet PMST	Sp.	The species lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains.	**Moderate** – marginal habitat within CPW and RFEF. Recent records 2 km S.
Reptilia							
Delma impar Striped Legless Lizard	V	V	-	PMST	Sp.	Found primarily in natural temperate grasslands and secondary grasslands nearby with significant content of exotic grasses and/ or surface rock. Distribution limit: ACT and surrounds.	**Unlikely** – does not occur within the Cumberland IBRA subregion.
Hoplocephalus bungaroides Broad-headed Snake	E	V	-	PMST	Sp.	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 25 km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring.	**Unlikely** – no suitable habitat and is restricted within the Cumberland IBRA subregion to the SW.
Varanus rosenbergi Rosenberg's Goanna	V	-	-	BAM-C	Sp.	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. Distribution limit: N-Nr Broke. S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn.	**Unlikely** – no suitable habitat (Sandstone outcropping)
Amphibian							
Heleioporus australiacus Giant Burrowing Frog	V	V	3	BioNet PMST BAM-C	Sp.	The species occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park, appearing to exist as 2 populations between Jervis Bay and Eden. Habitat for the species	**Unlikely** – no suitable habitat (sandstone substrate)

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						includes sandy soils supporting heath, woodland or open forest. The species breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	
Litoria aurea Green and Golden Bell Frog	E	V	3	BioNet PMST BAM-C	Sp.	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. Distribution limit: N-Byron Bay S-South of Eden.	**Low** – wetlands provide suitable habitat. One nearby record at Agnes Banks from1969. Closest recent record is from near Riverstone in 2016.
Litoria littlejohni Littlejohn's Tree Frog	E	E	-	PMST	Sp.	The species occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Habitat for the species includes permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	**Unlikely –** does not occur within the Cumberland IBRA subregion.
Mixophyes balbus Stuttering Frog	E	V	-	PMST	Sp.	The species occurs along the east coast of Australia. Habitat for the species includes rainforest and wet, tall, open forest, sheltering in deep leaf litter and thick understorey vegetation on the forest floor. Within Sydney Basin the species is now confined to populations in the Watagan Mountains, the southern Blue Mountains and Macquarie Pass. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts.	**Unlikely –** does not occur within the Cumberland IBRA subregion.
Pseudophryne australis Red-crowned Toadlet	V	-	17	BioNet	Sp.	Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. Distribution limit: N-Pokolbin. S-near Wollongong.	**Unlikely** – no suitable habitat.
Fish							
Macquaria australasica Macquarie Perch	V (*FM Act 1994*)	E	-	PMST	n/a	A riverine, schooling species, it prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water). Populations may survive in impoundments if able to access suitable spawning site.	**Unlikely** – no suitable habitat. Proposal area is outside of species' distribution.
Prototroctes maraena Australian Grayling	Part 2, Section 19 –	V	-	PMST	n/a	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000 m). Typically found in gravel	**Unlikely** – no suitable habitat. Proposal area is outside of species' distribution.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
	Protected Fish (*FM Act 1994*)					bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls).	
Migratory Species (nationally *threatened* migratory species are assessed above under the appropriate group. Nationally *protected* migratory fauna species are assessed below)							
Apus pacificus Fork-tailed Swift	-	M	-	PMST	n/a	The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia. They mostly occur over inland plains but sometimes above foothills or in coastal areas.	**Low** – suitable foraging in airspace over proposal area. No nearby recent records.
Calidris melanotos Pectoral Sandpiper	-	M	-	PMST	n/a	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	**Low** – suitable habitat within wetlands. No nearby recent records.
Gallinago hardwickii Latham's Snipe	-	M	-	PMST	n/a	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level.	**Low** – suitable habitat within wetlands. No nearby recent records.
Monarcha melanopsis Black-faced Monarch	-	M	-	PMST		Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. Summer breeding migrant to coastal south east Australia, otherwise uncommon.	**Low** – suitable habitat. No nearby recent records.
Motacilla flava Yellow Wagtail	-	M	-	PMST		The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops.	**Low** – suitable habitat. No nearby recent records.
Myiagra cyanoleuca Satin Flycatcher	-	M	-	PMST		Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	**Low** – suitable habitat within wetlands. No nearby recent records.
Rhipidura rufifrons Rufous Fantail	-	M	-	PMST	n/a	The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. Forages mostly in the air. The Rufous Fantail feeds on insects, which it gleans from the middle and lower levels of the canopy.	**Low** – no suitable habitat. No nearby recent records.
Tringa nebularia Common Greenshank	-	M	-	PMST		Found in a wide variety of inland wetlands and sheltered coastal habitats (with large mudflats and saltmarsh, mangroves or seagrass) of varying salinity, Habitats include embayments, harbours, river estuaries, deltas and lagoons. It uses both permanent and ephemeral	**Low** – suitable habitat within wetlands. No nearby recent records.

Species	Legal Status*		No. records (10 km)	Source#	BAM credit type	Habitat preferences, constraints & distribution	Likelihood of occurrence
	BC	EPBC					
						terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. Also artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. In NSW the Hunter River estuary has been identified as a site of international importance. Breeds in Eurasia, the northern British Isles, Scandinavia, east Estonia and north-east Belarus, through Russia and east.	

Appendix C: Plot-based field data sheets

Appendix D: Tests of Significance (BC Act)

Biodiversity Conservation Act 2016

As per Section 7.3 of the BC Act, the following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

Table D1: Test of Significance (BC Act)

	5-Part Test	Species	TEC
(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.	X	-
(b)	in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:		
(b) (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	-	X
(b) (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.	-	X
(c)	in relation to the habitat of a threatened species or ecological community:		
(c) (i)	the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and	X	X
(c) (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	X	X
(c) (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,	X	X
(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),	No AOBVs present	
(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.	X	X

Table D2: Threatened flora and TEC impact summary

Scientific name	*BC Act*	Potential to occur	Potential habitat impact
Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW)	CE	Recorded	Direct impact on TEC: removal of 0.34 ha
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	Recorded	Direct impact on TEC: removal of 1.36 ha
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWOCF)	CE	Recorded	Direct impact on TEC: removal of 0.55 ha

Table D3: Threatened fauna impact summary

Common name	BC Act	Potential to occur	Potential habitat impact
Regent Honeyeater	E	Moderate	Direct impact on potential foraging habitat
Dusky Woodswallow	V	Moderate	Direct impact on potential foraging and breeding habitat
Varied Sittella	V	Moderate	Direct impact on potential foraging and breeding habitat
Little Lorikeet	V	Moderate	Direct impact on potential foraging and breeding habitat
Swift Parrot	E	High	Direct impact on potential foraging habitat and mapped important habitat
Square-tailed Kite	V	Moderate	Direct impact on potential foraging and roosting habitat
Powerful Owl	V	Moderate	Direct impact on potential foraging and roosting habitat
Blue-billed Duck	V	Moderate	Direct impact on potential foraging and marginal breeding
Freckled Duck	V	Moderate	Direct impact on potential foraging and marginal breeding
Large-eared Pied Bat	V	Moderate	Direct impact on potential foraging and roosting habitat
Eastern false Pipistrelle	V	Recorded	Direct impact on potential foraging, roosting and breeding habitat

Common name	BC Act	Potential to occur	Potential habitat impact
Eastern Coastal Free-tailed Bat	V	Recorded	Direct impact on known foraging habitat and potential roosting and breeding habitat
Little Bent-winged Bat	V	Moderate	Direct impact on potential foraging and roosting habitat
Large Bent-winged Bat	V	Recorded	Direct impact on known foraging habitat and potential roosting habitat
Yellow-bellied Sheathtail - Bat	V	Moderate	Direct impact on potential foraging, roosting and breeding habitat
Southern Myotis	V	Recorded	Direct impact on known habitat
Greater Broad-nosed Bat	V	Recorded	Direct impact on known foraging habitat and potential foraging, roosting and breeding habitat
Grey-headed Flying-fox	V	Recorded	Direct impact on known foraging habitat

Threatened Ecological Communities

Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) – Critically endangered

Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) is listed as a critically endangered ecological community (CEEC) under the BC Act, and is facing an extremely high risk of extinction in NSW (NSW Scientific Committee 2010). This community is associated with clay soils derived from Wianamatta Group geology on the Cumberland Plain. CPW typically occurs on flat to undulating or hilly terrain up to about 350 metres elevation. It is typically characterised by a species-rich understorey of native tussock grasses, herbs and shrub layer comprised of *Bursaria spinosa, Acacia implexa, Indigofera australis* and *Dodonaea viscosa* subsp. *cuneata*. The canopy is typically dominated by *Eucalyptus moluccana* and *Eucalyptus tereticornis,* with other Eucalypts locally prevalent in lower abundance.

An update of mapping by Tozer (2003), based on interpretation of imagery flown in January-March 2007 shows that the extent of CPW east of the Hawkesbury – Nepean River had declined by 442±46 hectare, a reduction of 5.2±0.6% in 9 years (NSW Scientific Committee & Simpson 2008). The remaining area of the community is severely fragmented, with more than half of the remaining tree cover mapped by Tozer (2003) occurring in patches of less than 80 hectares and half of all mapped patches being smaller than 3 hectares. The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations (Young et al. 1996; Young & Clarke 2000).

Changes in structure contribute to a very large reduction in the ecological function of CPW. Almost all the remaining area of the community is regrowth forest and woodland from past clearing activities (Benson & Howell 1990).

Clearing and continuing degradation of CPW patches reduces the likelihood that all flora and fauna species will persist, particularly because a large proportion of species are known from very few locations which are not clustered in predictable ways (Benson & Howell 2002; Tozer 2003).

CPW occurs in the north of the proposal area, directly opposite and east of the intersection of Crooked Lane and Kurrajong Rd (Figure 3.2). East of Kurrajong Rd it is comprised mostly of canopy species, while the understorey is managed by mowing, while CPW to the west of Kurrajong Rd is unmanaged with a dense midstory of exotic shrubs and small trees (Photo 3.1). This TEC is associated with PCT 3320 within the proposal area. At a regional scale, 92% of this TEC is estimated to have been cleared with about 10,612hectares remaining in the Cumberland Plain landscape (DECCW 2010). The proposal will impact a total of 0.34 hectares of CPW, all of which is in a modified state and have been exposed to historical and ongoing disturbances associated with past land use practices, clearance, exotic species and edge effects from roadside disturbance.

River-Flat Eucalypt Forest – Endangered

River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) is listed as an endangered ecological community (EEC) under the BC Act, and is likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary development cease to operate (NSW Scientific Committee 2011a).

This community associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains of eastern NSW. This community generally occurs below 50 metres elevation but may occur on localised river flats up to 250 metres above sea level in the Sydney Basin. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically, these forests and woodlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. It is estimated that there is less

than 30% of the original distribution of this community remaining (NSW NPWS 2000). Less than 25% remained on the Cumberland Plain in 1998 (Tozer, 2003).

In the proposal area, RFEF occurs along the Hawkesbury River, with some smaller patches in the north of the proposal area (Figure 3.2). This community is associated with PCT 4025 within the proposal area, is dominated by *E. saligna* and *Casuarina cunninghamiana* and occurs in a modified condition with high abundance of exotic shrubs, vines and groundcovers present (Photo 3.4). At a regional scale, 86% of this TEC is estimated to have been cleared with about 5,313 hectares remaining on the Cumberland Plain (DECCW, 2010). The proposal will impact a total of 1.36 hectares of this EEC.

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – endangered

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (FWCF) is listed as an endangered ecological community (EEC) under the BC Act, and is likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary development cease to operate (NSW Scientific Committee 2011b).

FWCF occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally FWCF occur below 20 metres elevation on level areas. This TEC is characterised by a large assemblage of species that includes *Bolboschoenus fluviatilis, Ludwigia peploides* subsp*. montevidensis, Persicaria decipiens, Carex appressa, Persicaria lapathifolia, Phragmites australis* and *Typha orientalis*, among other native sedges and rushes.

660 hectares of FWCF, equivalent to 40% of the original extent, is estimated to remain on the Cumberland Plain (Tozer 2003). The remaining stands are severely fragmented by past clearing and are further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, filling associated with urban and industrial development, pollution and eutrophication from urban and agricultural runoff, weed invasion, overgrazing, trampling by livestock, soil disturbance by pigs, activation of 'acid sulfate soils' and rubbish dumping (NSW Scientific Committee, 2011b). The native fauna of FWCF is threatened by predation, particularly by mosquito fish and (in the north of the distribution) cane toads. Anthropogenic climate change may also threaten FWCF if sea levels rise and future flooding regimes change as predicted.

Within the proposal area, FWCF occurs surrounding the lagoons and waterbodies on the floodplains south of the Hawkesbury River (Figure 3.2) and is represented by PCT 3975. Condition within the proposal area is highly modified. The proposal will clear approximately 0.55 hectares of this PCT.

Table D4: Test of Significance for TECs

Factor	Assessment
Effect on life cycle of **threatened species**.	Not Applicable
(i) Effect on extent of **EEC** or **CEEC**.	10,612 hectares of CPW is estimated to remain on the Cumberland Plain, of which 976 hectares are conserved within reserves (DECCW, 2010). Locally, this TEC is conserved within the Scheyville National Park, approximately 10 km from the proposal area. 5,313 hectares of RFEF is estimated to remain on the Cumberland Plain, of which 112 hectares are conserved within reserves (DECCW, 2010). Locally, this TEC is conserved within the Blue Mountains and Cattai National Parks, approximately 6 km and 12 km, respectively, from the proposal area. 660 hectares of FWCF is estimated to remain on the Cumberland Plain (Tozer 2003). The most recent wetland mapping (OEH, 2010) shows 636 ha of floodplain wetlands within the Cumberland IBRA-subregion. This TEC is generally poorly conserved but is protected within the nearby Pitt Town Nature Reserve and Scheyville National Park (DPE 2023), approximately 8 and 10 km from the proposal area, respectively. The local occurrence of the TECs is considered to comprise the areas directly impacted by the project, and the areas potentially indirectly impacted through increased fragmentation and isolation. These areas include all contiguous areas of the CEEC extending from the linear study area and any patches that occur in the vicinity up to 100–200 m that are connected and allow movement of genetic material (pollen & seeds).

Factor	Assessment
	The proposal will clear approximately 0.34 ha, 1.36 ha and 0.55 ha of low-moderate condition Cumberland Plain Woodland, River-Flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains, respectively. This equates to 0.01% of CPW, 0.03% of RFEF, and 0.35% of FWCF within the Cumberland IBRA sub-region. Due to the relatively small clearance of each area of already modified vegetation, the action is unlikely to significantly impact the continued survival of these TECs.
(ii) Effect on composition of **EEC** or **CEEC**.	The proposal will chiefly impact these TECs through clearance of vegetation. The local occurrence of the CEEC is generally present in low-moderate condition and occurs in a fragmented landscape where introduced vegetation cover is significant and intensive historical land clearing has taken place over the past 150 years. Land use impacts from clearing, disturbance and grazing have reduced community integrity and functionality across the local landscape. Clearing for the proposal is unlikely to further reduce species diversity and simplify community structure more broadly. Each of these TECs already occurs in a modified, patchy and edge-effected state, and the proposal will not substantially increase these negative pressures. The adjacent areas of the TECs within the broader area will remain intact and are unlikely to suffer substantial changes in species composition. The vegetation to be directly removed does not comprise any ecological components critical to the survival of the TECs in the locality. The proposal is therefore not expected to alter the composition of these TECs such that their local occurrence is placed at risk of extinction.
(i) Extent of habitat removal or modification for **threatened ecological community**	The proposal will clear approximately 0.34 ha, 1.36 ha and 0.55 ha of low-moderate condition Cumberland Plain Woodland, River-Flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains respectively. As noted above, the proposal is not expected to substantially alter the composition of these TECs.
(ii) Extent of fragmentation or isolation of habitat for **threatened ecological community.**	The proposal area exists in a developed landscape where it is fringed by urban development, agricultural land, waterways and roads. As such, there is existing high levels of fragmentation within the locality. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated.
(iii) The importance of habitat to **threatened ecological community**.	Due to their size, generally in low condition, the TECs within the proposal area are not considered to retain high levels of ecological integrity and function. There is a minor risk that removal of this CEEC may present further edge effects to remaining patches of this community. Due to the conservation significance of the TECs, all remaining remnants are likely to be important for its long-term survival. However, patches in low condition that will be impacted have less importance where the ground layer is disturbed with high weed cover and the seedbank is degraded. It is unlikely that these TECs will recover to a high vegetation integrity without substantial restoration works.
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Clearing equates to 0.01% of CPW, 0.03% of RFEF, and 0.35% of FWCF within the Cumberland IBRA sub-region. Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The proposal will clear approximately 0.34 ha, 1.36 ha and 0.55 ha of low-moderate condition Cumberland Plain Woodland, River-Flat Eucalypt Forest and Southern Lower Floodplain Freshwater Wetland respectively. These TECs are modified with high abundance of exotic species, and are fragmented in most areas from surrounding remnant vegetation. The proposal will remove small areas of these TEC, but will not substantially modify their condition or increase fragmentation. The proposal is therefore unlikely to significantly impact the TECs such that their local occurrence is places at risk of extinction. Mitigation measures are detailed in Section 6. Offsetting is also to be undertaken for CPW vegetation as detailed in Section 7.2.1.

Threatened woodland birds

The following species were not recorded during targeted surveys, however suitable foraging and/or breeding habitat resides within the proposal area and recent records exists within the surrounding locality. Thirty-eight suitable hollows were observed, and five showed signs of use. The proposal area has not however, been mapped as important habitat for the Regent Honeyeater so breeding habitat is not present for that species.

Hollow-dependent:

- *Glossopsitta pusilla* (Little Lorikeet) – **Vulnerable**

Not hollow-dependent:

- *Anthochaera Phrygia* (Regent Honeyeater) - **Endangered**
- *Artamus cyanopterus* (Dusky Woodswallow) – **Vulnerable**
- *Daphoenositta chrysoptera* (Varied Sittella) - **Vulnerable**

Table D5: Test of Significance for woodland birds

Factor	Assessment
Effect on life cycle of **threatened species**.	The proposal will directly impact approximately 5.57 ha of habitat that may be suitable for foraging by threatened woodland birds. Suitable habitat exists within the proposal area and nearby records further indicate this. These species prefer Eucalypt-dominated open woodlands, where they may forage on insects, and nest in the forks and hollows of trees. The Regent Honeyeater however, prefers high nectar producing trees such as the Mugga ironbark and Swamp Mahogany, particularly where there is an abundance of mistletoes. This species is also unlikely to breed within the proposal area due to lack of important habitat No nests were observed during surveys, although suitable hollows were observed that may be utilised for breeding by Little Lorikeet. There are only small areas of suitable habitat occurring south of the North Richmond bridge, and the above species were not recorded during site surveys. Pre-clearance surveys are required in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* to mitigate impacts to this species (Section 6). There are larger, more suitable areas of habitat of multiple thousand hectares in the neighbouring Blue Mountains national park and in the retained vegetation south-west of the North Richmond bridge. These species are highly mobile and are able to move between areas of habitat where required. The small amount of area being cleared is therefore unlikely to significantly impact the long-term survival of these species.
(i) Effect on extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable
(i) Extent of habitat removal or modification for **threatened species**	The proposal will remove approximately 5.57 ha of suitable foraging habitat for the threatened woodland bird species plus up to 20 trees bearing 34 hollows that may provide breeding habitat for hollow-dependent species such as the Little Lorikeet. The threatened species habitat is generally present in low condition and occurs in a fragmented landscape where introduced vegetation cover is significant and intensive historical land clearing has taken place over the past 150 years. This habitat already occurs in a disturbed, patchy and edge-effected state, and the proposal will not substantially increase these negative pressures.. The vegetation to be directly removed does not comprise any ecological components critical to the survival of threatened birds in the locality. Large areas of more suitable habitat occur in the neighbouring Blue Mountains national park and in the retained vegetation south-west of the North Richmond bridge.

Factor	Assessment
(ii) Extent of fragmentation or isolation of habitat for **threatened species**	The proposal area exists in a developed landscape where it is fringed by urban development, agricultural land, waterways and roads. As such, there is existing high levels of fragmentation within the locality. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated. The proposal is therefore unlikely to fragment important habitat such that the continued survival of these species will be impacted.
(iii) The importance of habitat to **threatened species**, **populations** or **ecological community**.	In respect to threatened woodland bird species with potential to occur the proposed area of impact is not likely of high quality, of any breeding importance or central to the home range requirements of any species such that behaviour or ecology of these species will be significantly altered. These species are highly mobile and are able to utilise areas of better-quality habitat where required.
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The proposal will clear approximately 5.57 ha of suitable habitat for the above threatened species. Suitable hollows were detected indicating potential breeding habitat for the Little Lorikeet. The Regent Honeyeater is unlikely to breed in the study area. Mitigation measures are detailed in Section 6. Hollow replacement is also to be undertaken at a ratio of 3:1 (Section 7.2.2). Given the small extent of native vegetation being cleared and the large areas of suitable vegetation being retained southwest of the North Richmond Bridge and in the neighbouring national park, the proposal is unlikely to significantly impact the continued survival of these threatened species.

Pteropus poliocephalus (Grey-headed Flying-fox)

Grey-Headed Flying-foxes are canopy feeding frugivores and nectarivores, inhabiting a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. This species roosts in camps, which may contain tens of thousands of individuals.

Camps are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy. Camps can be found in riparian rainforest patches, *Melaleuca* stands, mangroves, riparian woodland or modified vegetation in urban areas. Loyalty to a site is high and some camps in NSW have been used for over a century. Some camps are used at the same time every year by hundreds of thousands of flying-foxes while others are used sporadically by a few hundred individuals. Generally foraging is within 20 kilometres of camps but individuals are known to commute up to 50 kilometres to a productive food source.

This species was recorded during site surveys foraging and flying overhead. The surrounding locality has numerous records although no roosting colonies were observed.

Table D6: Test of Significance for Grey-headed Flying-fox

Factor	Assessment
Effect on life cycle of **threatened species**.	The Proposal area likely represents foraging habitat only for the Grey-headed Flying-fox. The species was observed during surveys foraging and flying overhead, though no camps were found. Existing roosting colonies exist approximately 5 km south-west (Yarramundi, camp no. 97) of the proposal area and approximately 8.5 km east (Windsor, camp no.

Factor	Assessment
	1032) of the proposal area. It is likely that animals form those camps will forage within the proposal area on a regular basis. The proposal will remove approximately 5.57 ha of foraging habitat. Foraging habitat is otherwise well represented in the surrounding locality particularly where native vegetation (including Eucalypts) occur along Red Bank Creek and many other unnamed drainage channels in the locality, such that removal of habitat will not significantly impact on a local population.
(i) Effect on extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable
(i) Extent of habitat removal or modification for **threatened species**, **population** or **ecological community**	The proposed activity will require the clearing of approximately 5.57 ha of suitable foraging habitat for these species. This highly mobile species may utilise the proposal area as part of a broader area of foraging habitat, therefore the proposal is unlikely to significantly impact the continued survival of the species.
(ii) Extent of fragmentation or isolation of habitat for **threatened species**, **population** or **ecological community.**	Existing roosting colonies exist approximately 5 km south-west of the proposal area and approximately 8.5 km east of the proposal area. An existing roadway surrounded by urban development currently fragments remnant vegetation. The proposal is unlikely to significantly further impact the species due to the limited vegetation being removed, and the due to the species being highly mobile. Further, larger areas with more suitable habitat occur in the neighbouring Blue Mountains national park in the east, the Parr State conservation area occurring in the north, and in the retained vegetation southwest of the North Richmond Bridge. The proposal is therefore unlikely to significantly impact the continued survival of the species.
(iii) The importance of habitat to **threatened species**, **populations** or **ecological community**.	The habitat represents marginal foraging habitat, likely used as part of a much broader foraging landscape containing a variety of flowering and fruiting trees. As this species is a highly mobile forager able to utilise a large area, the limited area (5.57 ha) of habitat to be cleared is unlikely to significant impact the continued survival of the species.
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be insignificant.
Conclusion	The proposal will clear approximately 5.57 ha of suitable habitat for Grey-headed Flying-fox. Given the small extent of native vegetation being cleared and the large areas of suitable foraging resources in the surrounding landscape, the proposal is unlikely to significantly impact the continued survival of this threatened species.

Microbats

The Proposal area provides suitable foraging habitat, roosting, and breeding habitat for threatened microbats, although no evidence of breeding or roosting was recorded within the proposal area. Survey found that all observed culverts do not provide suitable roosting or breeding habitat for threatened microbats. The following species were recorded during site surveys:

- *Micronomus norfolkensis* (Eastern Coastal Free-tailed bat)
- *Miniopterus orianae oceanensis* (Large Bent-winged bat)
- *Myotis macropus* (Southern Myotis)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- *Falsistrellus tasmaniensis* (Eastern false Pipistrelle)

The following species have moderate potential to occur within the proposal area but were not recorded during survey:

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Miniopterus australis* (Little Bent-winged Bat)
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail – Bat)

Table D7: Test of Significance for microchiropteran bats

Factor	Assessment
Effect on life cycle of **threatened species**.	There is potential for suitable breeding, foraging and roosting habitat in tree hollows. Eastern Coastal Free-tailed bat, Large Bent-winged bat, Southern Myotis, Greater Broad-nosed bat and Eastern false Pipistrelle were recorded during targeted surveys and there are numerous records in the surrounding locality; though there was no evidence of breeding or roosting within the Proposal area. Culverts within the Proposal area do not provide suitable roosting or breeding habitat. The Southern Myotis will generally roost close to water, in tree hollows, under bridges and in dense foliage. Indeed, the Southern myotis was detected foraging under the existing bridge over the Hawkesbury River, though this area will not be impacted by the proposal. Caves are the primary breeding habitat for the Large Bent-winged Bat, the Large-eared Pied bat and the Little Bent-winged bat where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding – these are absent from the proposal area and assessment area. These species may roost in caves, tunnels, tree hollows (except Large-eared Pied bat) and occasionally old buildings. The remaining microbats may roost and breed in hollows or man-made structures, though no evidence of roosting was detected. These species are likely to utilise several roosting and breeding locations throughout the surrounding landscape, and often change roosting locations frequently. While use of the habitat resources within the proposal area may have gone undetected by recent survey, it is unlikely that this potential habitat is critical for the survival of local microbat populations. The locating of bat roost sites by survey is an exhaustive, costly and unreliable process. Therefore in the absence of recordings within proposed development areas the assessment for hollow-dependent threatened microbats is often based on the available habitat present and retained for the species within the locality that will support the local population. In this respect similar or better-quality roosting and breeding resources will remain extensive in the surrounding landscape. Careful habitat removal measures, relocation of suitable hollows and provision of supplementary habitat measures for this species have been considered and incorporated into the mitigation and amelioration of impacts outlined in Section 6. The unexpected species find procedure is to be followed under *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* and will ensure that if a colony is found to be roosting within the proposal area at the time

Factor	Assessment
	of habitat removal, this will be safely recovered and effectively relocated within the relevant hollow section. Suitable hollows within the development landscape will, where possible, also be similarly relocated to reduce the total impact of hollow removal in the immediate area. Established conservation areas (e.g. Blue Mountains National Park) and associated restoration measures as well as other areas of nearby local habitat will remain extensive, particularly where native vegetation occurs along the Hawkesbury River, Red Bank Creek and many other unnamed drainage channels in the locality, such that habitat removal within the Proposal area will not likely impact on the local populations of these species to any significant level. These species are highly mobile and can move between areas of habitat where required. Despite this it is recommended that to provide additional assurance of reducing the potential impact, pre-clearing surveys are to be undertaken within the Proposal area, and remaining southern study area. Given the large areas of suitable habitat occurring in the surrounding landscape, the proposal is unlikely to significantly impact the life cycle of these species.
(i) Effect on extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable
(i) Extent of habitat removal or modification for **threatened species**, **population** or **ecological community**	The proposed activity will require the clearing of up to 14.62 ha of vegetation that likely represents suitable foraging habitat for these species. 1.91 ha of species polygon habitat will be impacted for species credit species, Southern Myotis. For Large Bent-winged bat (recorded), Large-eared Pied Bat and Little Bent-winged Bat (moderate potential to occur), no habitat constraints for breeding habitat are present so no species polygon habitat will be impacted. 20 hollow-bearing trees with a total of 34 hollows, which may be used as breeding habitat by Eastern Coastal Free-tailed bat, Southern Myotis, Greater Broad-nosed Bat, Eastern false Pipistrelle and Yellow-bellied Sheathtail-bat, occur within the proposal area and will likely be removed for the proposal. Mitigation measures are provided in Section 6 in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* to mitigate impacts to these species. These species may utilise the Proposal area as part of a broader area of foraging habitat, although given the limited area of vegetation being cleared, the proposal is unlikely to significantly impact the continued survival of these species. Furthermore, more suitable habitat will be retained along Redbank Creek under the bridge, southwest of the North Richmond bridge and in the neighbouring Blue Mountains national park.
(ii) Extent of fragmentation or isolation of habitat for **threatened species**, **population** or **ecological community.**	The proposal area exists in a developed landscape where it is fringed by urban development, agricultural land, waterways and roads. As such, there is existing high levels of fragmentation within the locality. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated. The proposal is therefore unlikely to increase existing fragmentation of vegetation and is unlikely to significantly impact the continued survival of local populations of these species.
(iii) The importance of habitat to **threatened species**, **populations** or **ecological community**.	The proposal will clear approximately up to 14.62 ha of native vegetation providing foraging habitat and 1.91 ha of species polygon habitat will be impacted for species credit species, Southern Myotis. For Large Bent-winged bat (recorded), Large-eared Pied Bat and Little Bent-winged Bat (moderate potential to occur), no habitat constraints for breeding habitat are present so no species polygon habitat will be impacted. 20 hollow-bearing trees with a total of 34 hollows, which may be used as breeding habitat by Eastern Coastal Free-tailed bat, Southern Myotis, Greater Broad-nosed Bat, Eastern false Pipistrelle and Yellow-bellied Sheathtail-bat, occur within the proposal area and will likely be removed for the proposal. No caves were

Factor	Assessment
	present to provide breeding habitat for cave-dependant species (Large Bent-winged Bat, the Large-eared Pied bat and the Little Bent-winged bat). Larger areas of more suitable native vegetation in the neighbouring national park (particularly cave-dependant species) and in the retained vegetation and human-made structures surrounding the proposal area. The proposal is therefore unlikely to significantly impact habitat important for the continued survival of local populations.
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The proposal area provides foraging habitat for threatened microbat species recorded or with potential to occur within the study area. Potential roosting and breeding habitat is also present within recorded tree hollows for Eastern Coastal Free-tailed bat, Southern Myotis, Greater Broad-nosed Bat, Eastern false Pipistrelle and Yellow-bellied Sheathtail-bat. Mitigation measures are provided in Section 6 to ameliorate impacts to these species. It is unlikely that the prevalence of these species will be significantly impacted by the proposal considering the minor scale of the associated activities and likely extensive surrounding habitat.

Swift Parrot (*Lathamus discolor*)

The Swift Parrot is a migratory species that breeds in Tasmania and its offshore islands in summer, where it feeds mainly on nectar and lerp from eucalypt flowers, particularly Tasmanian Blue Gum (*Eucalyptus globulus*) (*NSW OEH* 2021) and Swamp Gum (*Eucalyptus ovata*) (DEWHA 2010). The proposal will therefore have no impact on breeding habitat for the species.

In late March almost the entire population migrates to mainland Australia spreading from Victoria through to central and coastal NSW and south east Queensland (*Schodde and Tidemann*, 1986). Movements on the mainland are nomadic and eruptive, moving in response to food supply, especially areas of heavily flowering eucalypts (Higgins 1999).

On the mainland, the Swift Parrot congregates where winter flowering species occur such as Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*) and Yellow Gum (*Eucalyptus leucoxylon*) (*Brown*, 1989). This species also occurs within Swamp Mahogany *(Eucalyptus robusta)* or Spotted Gum *(Corymbia maculata)* dominated communities along the coast. The TBDC (*NSW OEH* 2021) also indicates that Red Bloodwood (*C. gummifera*) and Forest Red Gum (*E. tereticornis*) may also be utilised. They also feed on lerps in *Eucalyptus* spp., including *E. moluccana*. In NSW, they forage in forests and woodlands throughout the coastal and western slopes region each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought.

Suitable foraging habitat exists within the proposal area and recent records have been recorded. Important habitat has been mapped along the riverbank although the species was not observed during surveys.

Table D8: Test of Significance for Swift Parrot

Factor	Assessment
Effect on life cycle of **threatened species**.	Swift parrots show site fidelity to certain areas or even specific stands of trees on the mainland; however, they do not necessarily return to these every consecutive year (Pfennigwerth 2008). Mainland distribution depends largely on food availability. While swift parrots have been shown to return to the same flowering street trees on the central coast of

Factor	Assessment
	NSW, large numbers of the species will not travel that far if the box-ironbark woodlands of central Victoria had sufficient food (Pfennigwerth 2008). Therefore, the number likely to utilise the winter flowering resources for foraging in the immediate locality will vary from year to year and are not likely to visit most years. Records of the species from BioNet indicate that only in one year (2002) where at least 100 birds recorded visiting North Richmond. In most years sightings have recorded <10 individuals. We note that there have been very close sightings of the species in recent years and we expect that given there are quite reasonable resources available (nectar) during winter, that it is possible that in any given year they could occur within the study area. The proposal will not directly affect the lifecycle of Swift Parrot, but the removal of 5.57 ha total potential foraging habitat, including 0.93 ha of mapped important habitat, contributes to cumulative impacts that may ultimately influence this species' ability to maintain a migratory lifecycle.
(i) Effect on extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable
(i) Extent of habitat removal or modification for **threatened species**, **population** or **ecological community**	The proposed activity will remove 5.57 ha potential foraging habitat, including 0.93 ha of mapped important habitat for Swift Parrot. The threatened species habitat is generally present in low and low-moderate condition and occurs in a fragmented landscape where introduced vegetation cover is significant and intensive historical land clearing has taken place over the past 150 years. Land use impacts from clearing, disturbance and grazing have reduced community integrity and functionality across the local landscape. Clearing for the proposal is unlikely to further reduce species diversity. This habitat already occurs in a disturbed, patchy and edge-effected state, and the proposal will not substantially increase these negative pressures. The adjacent areas of habitat within the broader area will remain intact and are unlikely to suffer substantial changes in species composition. The vegetation to be directly removed does not comprise any ecological components critical to the survival of threatened birds in the locality. Large areas of more suitable habitat occur in the neighbouring Blue Mountains National Park (6 km west) and in the retained riverside vegetation south-west of the North Richmond bridge (adjacent to the Study Area). In addition, Important Area Mapping for the species in the locality includes larger areas of intact vegetation along the Redbank River that intersects the northern section of the proposal, which includes *Eucalypts crebra*, an ironbark that flowers in all months. In addition, it includes areas of native vegetation along the Hawksbury River banks either side of the proposal that include *E. tereticornis* which provides winter flowering resources for the species.
(ii) Extent of fragmentation or isolation of habitat for **threatened species**, **population** or **ecological community.**	The proposal area exists in a developed landscape where it is fringed by urban development, agricultural land, waterways and roads. As such, there is existing high levels of fragmentation within the locality. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated. These species are migratory and highly mobile. The proposal is therefore unlikely to fragment important habitat such that the continued survival of these species will be impacted.
(iii) The importance of habitat to **threatened species**, **populations** or **ecological community**.	The species is only likely to utilise *E. tereticornis* and *E. moluccana* trees for foraging in the north of the proposal area associated with PCT 3320 and 4025. The remaining habitat on the riverbanks and within planted vegetation represents more marginal foraging habitat, containing *Casuarina* and other Eucalypt species that do not provide high-quality winter foraging. Surrounding areas containing higher abundance of *E. tereticornis* provide more important winter foraging resources. Important Area Mapping for the species in the locality includes larger areas of intact vegetation along the Redbank River that intersects the northern section of the proposal, which includes *Eucalypts crebra*, an ironbark that flowers in all months. In addition, it includes areas of native vegetation along the Hawksbury River banks either side of the proposal that include *E. tereticornis* which provides winter flowering resources for the species.

Factor	Assessment
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The proposal area represents a small area of suitable foraging habitat for the Swift Parrot. It is unlikely that the prevalence of this species within the locality will be significantly impacted by the proposal considering the minor scale of the associated activities.

Birds of Prey

Lophoictinia isura (Square-tailed Kite)

Though this species was not detected within the proposal area and there was no evidence of nesting or roosting, records exist within the surrounding locality. This species particularly prefers timbered watercourses and open forest which is present in the proposal area.

Table D9: Test of Significance for Square-tailed Kite

Factor	Assessment
Effect on life cycle of **threatened species.**	The proposal will clear approximately 14.62 ha of native vegetation providing potential foraging habitat. Square-tailed kites typically nest near watercourses in mature tree forks and along limbs in large nests, though no large nests were observed within the proposal area. Targeted survey in October and November did not detect any stick nests within the proposal area, therefore it is assumed that the proposal will not impact on any breeding habitat for this species. The proposal will not significantly effect the lifecycle of this species.
(i) Effect on extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable
(i) Extent of habitat removal or modification for **threatened species, population** or **ecological community**	The proposal will clear approximately 14.62 ha of native vegetation that likely represents foraging habitat, though pre-clearance surveys are required in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* to mitigate impacts to this species. Larger areas of more suitable vegetation will be retained southwest of the North Richmond bridge (where native vegetation extends along the river bank, adjacent to the study area) and in

Factor	Assessment
	the neighbouring Blue Mountains National Park, 6 km west. Given the extensive home range of the Square-tailed kite (approximately 50 km^2 (OEH, 2009)), the proposed removal of low-moderate quality foraging habitat is unlikely to significantly impact the continued survival of the species.
(ii) Extent of fragmentation or isolation of habitat for **threatened species, population** or **ecological community.**	The proposal area exists in a developed landscape where it is fringed by urban development, agricultural land, waterways and roads. As such, there is existing high levels of fragmentation within the locality. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated. These species are highly mobile with large home ranges therefore the proposal is unlikely to fragment important habitat such that the continued survival of this species will be impacted.
(iii) The importance of habitat to **threatened species, populations** or **ecological community.**	The proposed proposal area is not of high quality, of any breeding importance or central to the home range requirements of this species such that behaviour or ecology of this species will be significantly altered.
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The Proposal area represents marginal foraging habitat for the Square-tailed kite known to occur within the locality. It is unlikely that the prevalence of this species within the locality will be significantly impacted by the proposal considering the low condition of impacted vegetation and large areas of similar habitat in the surrounding landscape.

Threatened Forest Owl Species

Ninox strenua (Powerful Owl)

The Powerful Owl is the largest owl in Australasia and as such requires large tree hollows (>20 cm diameter, minimum of 4 m high and at least 0.5 m deep) to support breeding. Through recent records exist within the locality, no suitable hollows were observed within the proposal area and the extent of clearance of native vegetation likely represents foraging habitat only.

Table D10: Test of Significance for Powerful Owl

Factor	Assessment
Effect on life cycle of **threatened species.**	The proposal will clear approximately 14.62 ha of native vegetation likely representative of foraging habitat only. Although recent records exist within the locality, the Powerful owl requires very large hollows and large tracts of closed woodland forest to breed, which are not present within the proposal area. Larger areas of more suitable habitat exist in the neighbouring national park and in the retained native vegetation southwest of the North Richmond bridge. As the Powerful owl is known to have a home range of approximately 400 ha, the extent of cleared native vegetation likely represents a fraction of utilised foraging habitat and is therefore unlikely to significantly impact the continued survival of the species.
(i) Effect on the extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable
(i) Extent of habitat removal or modification for **threatened species, population** or **ecological community**	The proposal will require the clearing of approximately 14.62 ha of native which represents marginal foraging habitat, although pre-clearance surveys are required in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024)* to mitigate impacts to this species. The lack of large suitable hollows within the proposal area indicate that the area does not provide breeding habitat. Also, a larger area of more suitable habitat exists in the nearby Blue Mountains National Park (less than 6 km to the west of the Proposal area) and as such the proposal is unlikely to significantly impact the continued survival of the species.
(ii) Extent of fragmentation or isolation of habitat for **threatened species, population** or **ecological community.**	The proposal area exists in a developed landscape where it is fringed by urban development, agricultural land, waterways and roads. As such, there is existing high levels of fragmentation within the locality. The greatest connectivity is to the NW and will not be impacted. Impacts elsewhere will reduce size of fragments but not lead to any additional isolation of fragments that are not already isolated. The proposal is therefore unlikely to fragment important habitat such that the continued survival of this species will be impacted. In addition, the species is highly mobile with a large home range , and therefore is not likely to be impacted by clearing of foraging habitat at this scale.
(iii) The importance of habitat to **threatened species, populations** or **ecological community.**	The proposed proposal area is not of high quality, of any breeding importance or central to the home range requirements of this species such that behaviour or ecology of this species will be significantly altered.
Area of Outstanding Biodiversity Value	Not Applicable

Factor	Assessment
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The Proposal area represents marginal foraging habitat for the *Ninox strenua* (Powerful Owl). It is unlikely that the prevalence of this species within the locality, will be significantly impacted by the proposal considering the low condition of impacted vegetation and large areas of similar habitat in the surrounding landscape.

Ducks

Oxyura australis (Blue-Billed Duck) and *Stictonetta naevosa* (Freckled Duck)

The Blue-Billed Duck and the Freckled duck have few records within the locality (160–320 m from the Proposal area) (Pugh's lagoon just north of Richmond) and were not observed during surveys. These ducks prefer large areas of permanent wetland in which only small areas of wetland vegetation in the proposal area will be impacted (0.55 hectares). Larger areas of suitable habitat exist within the wetlands and lagoons (Bakers, Bushells and Pitt Town lagoons) on the floodplains outside of the proposal area. The proposal is therefore unlikely to significantly impact the continued survival of these species.

Table D11: Test of Significance for threatened ducks

Factor	Assessment
Effect on life cycle of **threatened species.**	The proposal will clear approximately 0.55 ha of potential suitable habitat. Both the Blue-Billed duck and the Freckled duck prefer large areas of permanent wetlands and the Blue-Billed duck, in particular, is completely aquatic, nesting in Cumbungi (*Typha* spp.) over deep water. The Freckled duck is also known to nest in Cumbungi. The proposal area does not contain any large areas of Cumbudgi or deep water and therefore provides minimal breeding habitat for these species. The proposed clearance is minor, confined to edges of wetland habitat, and will not impact the large bodies of water in the proposal area. Also, large areas of more suitable habitat exist on the floodplains north of the proposal area, particularly in Bakers, Bushells and Pitt Town lagoons. Further, the species has minimal records within the locality and was not observed during surveys, suggesting they do not use the local waterbodies frequently. Thus, the proposal is unlikely to significantly impact the lifecycle of these species.
(i) Effect on the extent of **EEC** or **CEEC**.	Not Applicable
(ii) Effect on composition of **EEC** or **CEEC**.	Not Applicable

Factor	Assessment
(i) Extent of habitat removal or modification for **threatened species, population** or **ecological community**	The proposal will remove approximately 0.55 ha of suitable habitat for this species, although this area is negligible given the species prefer larger, permanent wetlands. The large bodies of water, creeks, rivers and lagoons adjacent to the proposal area will not be directly impacted. More suitable habitat will be retained southwest of the North Richmond bridge and in the neighbouring national park. These species were not observed during surveys. Thus the extent of habitat removal is consider marginal and will not significantly impact the continued survival of the species.
(ii) Extent of fragmentation or isolation of habitat for **threatened species, population** or **ecological community.**	The proposal will clear approximately 0.55ha of suitable habitat although more suitable habitat along the Hawksbury river and Pugh's lagoon will be retained and not directly impacted. The Proposal area exists in a developed landscape where it is fringed by urban developments. As such, there is existing fragmentation between remnant vegetation within the locality, though this fragmentation is considered negligible given the species mobility and preference for large water bodies. The proposal will not further fragment or isolate existing habitat for the species and is unlikely to significantly impact the continued survival of the species.
(iii) The importance of habitat to **threatened species, populations** or **ecological community.**	The proposal will clear approximately 0.55 ha of suitable habitat, though nearby areas of more suitable habitat exist on the floodplains north of the proposal area, particularly in Bakers, Bushells and Pitt Town lagoons. These areas are outside of the proposal area and will not be impacted. The proposal area is therefore likely considered as habitat of low importance and is unlikely to significantly impact the continued survival of these species.
Area of Outstanding Biodiversity Value	Not Applicable
Key Threatening Processes	Key Threatening Processes relevant to the proposed development: - Clearing of native vegetation Given the small scale of proposed clearing within the Proposal area, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	The proposal will clear approximately 0.55 ha of suitable habitat. This area is small and of marginal importance considering these species affinity for larger areas of permanent wetland with deeper water and dense stands of Cumbudji. More suitable areas of habitat exist on the floodplains north of the proposal area, particularly in Bakers, Bushells and Pitt Town lagoons which will not be directly impacted by the development. The development is therefore unlikely to significantly impact the continued survival of the species.

Appendix E: Assessments of significance (EPBC Act)

Species Assessed under the EPBC Act Significant Impact Guidelines

The following pertains to Assessments of Significance for direct or indirect impacts to EBPC Act listed threatened species, populations, and communities.

The following species have been assessed under the EPBC Act *Matters of National Environmental Significance*

Significant impact guidelines 1.1 (Department of the Environment [DoE], 2013) (Significant Impact Guidelines):

Critically Endangered Species

- *Lathamus discolor* (Swift Parrot)
- *Anthochaera phrygia* (Regent Honeyeater)

Vulnerable Species

- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)

Critically Endangered and Endangered Species – EPBC Act Assessment of Significance

The *EPBC Act Significant Impact Guidelines* (DoE 2013) state:

- 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:
    - lead to a long-term decrease in the size of a population
    - reduce the area of occupancy of the species
    - fragment an existing population into two or more populations
    - adversely affect habitat critical to the survival of a species
    - disrupt the breeding cycle of a population
    - modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
    - result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
    - introduce disease that may cause the species to decline, or
    - interfere with the recovery of the species.

- A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:
    - a geographically distinct regional population, or collection of local populations, or
    - a population, or collection of local populations, that occurs within a particular bioregion.

- An 'invasive species' is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources, or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.
    - Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:
    - for activities such as foraging, breeding, roosting, or dispersal
    - for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
    - to maintain genetic diversity and long-term evolutionary development, or
    - for the reintroduction of populations or recovery of the species or ecological community.

- Such habitat may be but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

Environment Protection and Biodiversity Conservation Act 1999

Critically Endangered species

- *Lathamus discolor (Swift Parrot)*

Lead to the long-term decrease in the size of a population.

The Swift Parrot does not breed in the study area and the extent of habitat remaining in the locality area likely provides 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.

The Swift Parrot is known to breed in Tasmania during spring and summer, migrating along the east coast of Australia during winter. As such, the vegetation within the proposal area does not constitute important habitat for breeding.

Swift Parrot 'important area' mapping does occur within the proposal area along the riverbank, with multiple records of the species made within the locality. This species may feed on winter-flowering *E. tereticornis* and lerps within host trees such as *E. moluccana*. Whilst the proposal area is unlikely to constitute key dispersal habitat, it is likely to be represent part of a broader area of foraging habitat for the species within the region.

Impacts to potential foraging habitat is minimal. The proposal will require the clearing of approximately 5.57 hectares total of potential foraging habitat, including 0.93 hectares of mapped important habitat. The species may utilise the proposal area as part of a broader area of foraging habitat, however larger areas of suitable habitat occur in the surrounding landscape, particularly in nearby reserves and National Parks. Within the Cumberland subregion, the potential habitat removal represents a small proportion of currently available habitat for this species.

Records of this species occur within the surrounding locality although this species was not observed during surveys.

As such, the proposal will only impact potential marginal foraging habitat for the species. The proposed activity is therefore considered unlikely to lead to a long-term decrease in the size of an important population of the Swift Parrot.

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 proposal will contribute to the loss of potential foraging habitat which will reduce the area of habitat available. However, the action, removing approximately 5.57 hectares total of potential foraging habitat, including 0.93 hectares of mapped important habitat, will not reduce the area of occupancy of this species which is estimated at 4,000 square kilometres.

Fragment an existing population into two or more populations.

The proposal area borders an existing roadway in a development landscape where it is fringed by urban developments. This species is highly mobile and, as a regular behaviour, flies long distances over open areas to move between suitable foraging habitats. The action will not affect the movement of the Swift Parrot between habitat patches or fragment the population. The action is considered unlikely to fragment existing populations as movement corridors within the locality will remain intact.

The proposal is therefore unlikely to increase existing fragmentation of vegetation and is unlikely to significantly impact the continued survival of the population.

Adversely affect habitat critical to the survival of a species.

No breeding habitat for the Swift Parrot occurs within the proposal area (species breeds in Tasmania), as such it is unlikely that the proposal will significantly impact the breeding cycle of the species. The proposal area supports winter foraging resources and is also mapped as Important Habitat, therefore we consider that important habitat for this species is present. The impact on 0.93 hectares of important habitat for this species is not likely to critically impact the species such that it's immediate survival is put a risk.

Disrupt the breeding cycle of a population.

The Swift Parrot is a non-breeding visitor to the Australian mainland, breeding exclusively in Tasmania, as such the proposal will not impact on winter breeding habitat.

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

The proposed development will impact on approximately 5.57 hectares total of potential foraging habitat, including 0.93 hectares of mapped important habitat. As a large-scale migrant, it has the ability to cover vast areas of its winter range, seeking suitable flowering eucalypt habitat. The species is an occasional visitor to the region and may utilise trees in the study area for foraging intermittently when no other suitable resources are available. The proposal 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.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat.

The proposal area is highly disturbed and already contains a high abundance of invasive species. The proposal is not expected to increase the prevalence of these species such that they impact on Swift Parrot.

Introduce disease that may cause the species to decline.

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

Interfere substantially with the recovery of the species.

The proposed development will not interfere with the recovery of the species due to low level of impact and proposed offsets (see Section 7). Replacement plantings in accordance with the Tree and Hollow Replacement Guidelines (Transport, 2023d) should use winter-flowering species such as *E. tereticornis* where possible to provide a positive increase in potential foraging habitat for this species.

- *Anthochaera Phrygia (Regent honeyeater)*

Lead to the long-term decrease in the size of a population.

The Regent honeyeater has patchy distribution from southeast Queensland to central Victoria, preferring to forage in mature box-ironbark woodland, abundant in eucalypt nectar and mistletoe. The species breeding habitat is confined to the Capertree Valley and Bundarra-Barraba region and the proposal area has not been mapped as Important Habitat for the species. The proposal will therefore clear approximately 5.57 hectares of potential foraging habitat only.

Impacts to potential foraging habitat is minimal. The species may utilise the proposal area as part of a broader area of foraging habitat, in which larger areas of more suitable habitat occur within the surrounding landscape, including nearby nature reserves and Blue Mountains national park.

Records of this species occur within the surrounding locality although this species was not observed during surveys.

As such, the proposed activity will only impact marginal, potential foraging habitat. The proposal is therefore considered unlikely to lead to a long-term decrease in the size of an important population of the Regent Honeyeater, such that the continued survival of the species is impacted.

Reduce the area of occupancy of the species.

The proposed development will impact on approximately 5.57 hectares of native vegetation and is unlikely to significantly reduce the area of occupancy of a population.

Fragment an existing population into two or more populations.

The proposal area borders an existing roadway in a development landscape where it is fringed by urban developments. This species is highly mobile and is known to migrate between coastal and inland regions of NSW, and flies long distances over open areas to move between suitable foraging habitats. The proposal will not affect the movement of the Regent Honeyeater between habitat patches or fragment the population. The action is considered unlikely to fragment existing populations as movement corridors within the locality will remain intact.

The proposal is therefore unlikely to increase existing fragmentation of vegetation and is unlikely to significantly impact the continued survival of the population.

Adversely affect habitat critical to the survival of a species.

No breeding habitat for the Regent Honeyeater occurs within the study area (species breeds in Capertree Valley and the Bundarra-Barraba region), as such it is unlikely that the proposal will significantly impact the breeding cycle of the species. No mapped Important Habitat occurs within the proposal area.

Disrupt the breeding cycle of a population.

The Regent Honeyeater breeds in Capertree Valley and the Bundarra-Barraba region. As such it is highly unlikely that the proposal will significantly impact the continued survival of the species.

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

The proposed development will impact on approximately 5.57 hectares of habitat which represents marginal foraging habitat for the species. This impact represents a relatively small proportion of the remaining vegetation. The species is an occasional visitor to the region and may utilise trees in the study area for foraging intermittently when no other suitable resources are available. The proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat.

The proposal area is highly disturbed and already contains a high abundance of invasive species. The proposal is not expected to increase the prevalence of these species such that they impact on Regent Honeyeater.

Introduce disease that may cause the species to decline.

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

Interfere substantially with the recovery of the species.

The proposed development will not interfere with the recovery of the species due to low level of impact and proposed offsets (see Section 7). Replacement plantings in accordance with the Tree and Hollow Replacement Guidelines (Transport, 2023d) should use winter-flowering species such as *E. tereticornis* where possible to provide a positive increase in potential foraging habitat for this species.

Endangered species – EPBC Act Assessment of Significance

Endangered Species

Vulnerable species – EPBC Act Assessment of Significance

Vulnerable Species

Pteropus poliocephalus (Grey-headed Flying-fox)

Lead to the long-term decrease in the size of an important population of the species.

This species was observed during surveys foraging in trees and flying overhead the proposal area. There was no evidence of roosting colonies although the proposal area contains suitable foraging habitat for this species.

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

The proposed development will impact on approximately 5.57 hectares of native vegetation, representing potential foraging habitat for these species. The desktop research and survey confirmed there are no roost camps present within the proposal area. The action will not affect any known permanent roosting, breeding / maternity

sites. Therefore, it is likely that the impacts of the action will 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. Due to the relatively small impact on potential foraging habitat for these species, it is unlikely that the proposal will lead to the long-term decline of any potentially occurring important populations.

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.

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 will remain the same after the action. No decrease in the area of occupancy for this species is expected as a result of the proposal.

Fragment an existing 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 will not fragment an important population of the Grey-headed Flying-fox. Individuals will still be able to disperse between roosts along the east Australian coast. Genetic exchange within the population and dispersal will not be disrupted by the proposal.

The proposal is therefore unlikely to increase existing fragmentation of vegetation and is unlikely to significantly impact the continued survival of the population.

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 proposal area 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 Yarramundi, Windsor, Ropes Crossing, Emu Plains and Penrith camps.

The recovery plan for the Grey-headed Flying-fox identifies critical foraging habitat for this species as:

- Winter and spring flowering native vegetation
- native species that are known to be productive as foraging habitat during the final weeks of gestation, and during the weeks of birth, lactation and conception (August to May)
- native species used for foraging and occur within 20 kilometres of a nationally important camp as identified on the Department's interactive flying-fox web viewer, or
- native and or exotic species used for roosting at the site of a nationally important Grey-Headed Flying-Fox camp1 as identified on the Department's interactive flying-fox web viewer.

Native vegetation within the study area may constitute critical foraging habitat but the affected area of foraging habitat represents 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.

Disrupt the breeding cycle of an important population.

No breeding habitat for these species was identified within the Study Area, although breeding colonies occur approximately 5km south-west of the proposal area and approximately 8.5 kilometres east of the proposal area. The proposal will impact vegetation that is unlikely to significantly disrupt the breeding cycle of this species or significantly impact the continued survival of the species. The proposal will not directly impact on a known roost

camp / breeding or maternity site. Alternative foraging resources are available in the locality that provide suitable resources during the maternity season.

Modify, destroy, remove, 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.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The proposal area is highly disturbed and already contains a high abundance of invasive species. The proposal is not expected to increase the prevalence of these species. The action is unlikely to result in an invasive species harmful to the Grey-headed Flying-fox becoming established in the habitat.

Introduce disease that may cause the species to decline.

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

Interfere substantially with the recovery of the species.

The proposed development will not interfere with the recovery of the species due to low level of impact and proposed offsets (see Section 7). Replacement plantings in accordance with the Tree and Hollow Replacement Guidelines (Transport, 2023d) should use winter-flowering species such as *E. tereticornis* where possible to provide a positive increase in potential foraging habitat for this species.

Chalinolobus dwyeri (Large-eared pied-bat)

Lead to the long-term decrease in the size of an important population of the species.

In the case of a vulnerable species, an important population is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- Key source populations either for breeding or dispersal; or
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

The identification of potential foraging habitat for this vulnerable species does not constitute the presence of an 'important population' as defined by the criteria listed above, as any potentially occurring individuals within the study area do not represent a key source population either for breeding or dispersal; the study area is not important for the maintenance of genetic diversity of the species; and the species is not at the limits of its range in the study area. Therefore, the study area is not likely to contain an important population of the large-eared pied bat. Further, the National Recovery Plan for the large-eared pied bat (DERM 2011) states that habitat critical for the survival of the species requires the presence of diurnal roosts and shelter habitat, usually in the form of sandstone cliffs and adjacent fertile woodland valley foraging habitat. The majority of records of the species occur within several km of cliff lines or caves. Due to the absence of suitable cliff lines or cave roosting habitat within the study area, it is not considered to contain important habitat for the species. This species was not detected during surveys but has moderate potential to use the proposal area for foraging use only. Large-eared Pied-bat requires a combination of sandstone cliff/escarpment to provide roosting habitat, while breeding and nursery roosts have very specific requirements, i.e. arch caves with dome roofs (that need to be deep enough to allow juvenile bats to learn to fly safely inside) and with indentations in the roof (presumably to allow the capture of heat). These physical characteristics are not very common in the landscape and therefore a limiting factor in the distribution of the species. No such features are present within the proposal area or nearby.

The proposed development will impact on approximately 14.85 hectares of native and exotic vegetation, representing potential foraging habitat for this species. The action will not affect any known permanent roosting, breeding / maternity sites. Therefore, it is likely that the impacts of the action will be confined to minor loss of foraging habitat caused by direct clearing or damage to native vegetation during the construction phase. Due to the relatively small impact on potential foraging habitat for these species, it is unlikely that the proposal will lead to the long-term decline of any potentially occurring important populations.

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.

Reduce the area of occupancy of an important population.

The area of occupancy of the Grey-headed Flying-fox is estimated at 9120 square kilometres. The area occupied by this species will remain the same after the action. No decrease in the area of occupancy for this species is expected as a result of the proposal.

Fragment an existing population into two or more populations.

Highly mobile species such as bats are expected to be less impacted by fragmentation. The Large-eared Pied-bat is known to forage several kilometers from roost sites and may travel up to 100 kilometres between maternity and winter roosts (SPRAT profile). The proposal will not fragment an important population of this species as individuals will still be able to disperse between roosts and foraging areas within its range. Genetic exchange within the population and dispersal will not be disrupted by the proposal.

The proposal is therefore unlikely to increase existing fragmentation of vegetation and is unlikely to significantly impact the continued survival of the population.

Adversely affect habitat critical to the survival of a species.

The species is dependent on the presence of diurnal roosts such as caves, overhangs, or other landscape features for shelter. Large-eared Pied-bat roosting habitat includes areas with cliffs, escarpments or rocky outcrops, typically sandstone but also rhyolite in central-eastern NSW and south-eastern and central Qld. The structure of maternity roosts appears to be particularly specific (arched caves with domed roofs), which mean appropriate caves are uncommon in the landscape. Any known roost site, or caves that could be roost sites, are considered habitat critical to the survival of the species. No suitable features likely to provide such habitat are present within the proposal area or nearby but the nearby Blue Mountains National Park likely provides suitable habitat.

The proposal will not adversely affect habitat critical to the survival of this species in this region.

Disrupt the breeding cycle of an important population.

No breeding habitat for these species was identified within the proposal area nor is it expected to occur. The breeding requirements for this species are very specific, as discussed above, and the proposal will not disrupt the breeding cycle of this species or significantly impact the continued survival of the species.

Modify, destroy, remove, 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 potential breeding or roosting habitat occurs within 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.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The proposal area is highly disturbed and already contains a high abundance of invasive species. The proposal is not expected to increase the prevalence of these species. The action is unlikely to result in an invasive species harmful to the Large-eared Pied-bat becoming established in the habitat.

Introduce disease that may cause the species to decline.

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

Interfere substantially with the recovery of the species.

Actions identified in the species recovery plan (DERM 2011) are not pertinent to the proposal as they are primarily concerned with known and potential roost / breeding sites. The proposed development will not interfere with the recovery of the species due to low level of impact and proposed offsets (see Section 7). Replacement plantings in accordance with the Tree and Hollow Replacement Guidelines (Transport, 2023d) will provide a positive increase in potential foraging habitat for this species.

Appendix F: Biodiversity credit reports

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NSW GOVERNMENT

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 30/10/2023	Richmond Bridge	1201	GP DP

GF		Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Eucalyptus tereticornis	✓			15	2	
	2	Eucalyptus saligna	✓			15	1	
	3	Casuarina glauca	✓			5	1	
	4	Acacia parramattensis	✓			2	1	
	5	Melaleuca sieberi	✓			8	1	
	6	Acacia sp. Acacia fimbriata	✓			4	2	✓
	7	pinnate tree Toxicodendron succedaneum (Rhus tree)		✓		1	1	✓
	8	Chloris gayana			✓	0.1	5	
	9	Sporobolus africanus		✓		0.1	5	
	10	~~Stenotaphrum secundatum~~ Axonopus fis.			✓	2	50	
	11	Cynodon dactylon	✓			80	5000	
	12	Passiflora ? suberosa	✓	✓	✓	0.1	3	ph.v.
	13	Glycine tabacina	✓			0.1	3	
	14	grass 1 Rostraria cristata		✓		2	40	✓
	15	Ehrharta erecta			✓	10	200	✓
	16	Dichondra repens	✓			0.1	5	
	17	Sida rhombifolia	✓	✓		0.1	10	
	18	Solanum nigrum		✓		0.1	1	
	19	Ligustrum sinense			✓	0.1	3	
	20	Taraxacum officinale		✓		0.1	1	
	21	Acanthospermum hispidum		✓		0.1	3	
	22	Verbena bonariensis		✓		0.1	1	
	23	Araujia sericifera			✓	0.1	1	
	24	Fragaria vesca			✓	1	20	
	25	Bromus catharticus		✓		0.1	3	
	26	Modiola caroliniana		✓		0.1	3	
	27	Clematis aristata	✓			0.1	1	
	28							
	29							
	30							
	31							
	32							
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 30/10/2023	Richmond Bridge	G02	GF DP

GF	Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1 Eucalyptus tereticornis	N			20		
	2 Angophora floribunda	N			4		
	3 Melia azedarach	N			~~50~~ 8	[illegible]	
	4 Ligustrum sinense			✓	50	200	
	5 Ligustrum lucidum			✓	30	80	
	6 Cat's claw Dolichandra unguis-cati				10	20	
	7 Passiflora suberosa				5	10	
	8 Lantana camara			✓	10	50	
	9 Ochna serrulata			✓	2	20	
	10 Olea europaea			✓	5	1	
	11 Solanum mauritianum		✓		0.1	3	
	12 Eucalyptus moluccana	✓					
	13 Senna pendula			✓	0.1	3	
	14 Tradescantia fluminensis			✓	0.4	100	
	15 Lomandra Filiformis	✓			0.1	5	
	16						
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3….. 1, 2, 3 ……. 10, 15, 20, 25 ……100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3…10, 20, 30….100, 200…1000…

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 31/10/2023	Richmond Bridge	QB03	QP DD

GF		Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Cenchrus clandestinus			✓	60	3000	
	2	Trifolium repens		✓		10	500	
	3	Hypochaeris radicata		✓		0.2	50	
	4	Vicia sativa		✓		2	100	
	5	Bromus catharticus		✓		3	200	
	6	Cammichaelia sp.		✓		0.1	20	
	7	Conyza bonariensis		✓		0.1	20	
	8	Medicago sp		✓		2	50	
	9	Paspalum dilatatum			✓	10	200	
	10	Cynodon dactylon	✓			5	1000	
	11	Salvia sessilis		✓		1	200	
	12	grass \ Rostraria cristata		✓		0.1	20	
	13	Poa annua (dead)		✓		0.1	20	
	14	Aster subulata		✓		0.1	3	
	15	Modiola caroliniana		✓		0.1	10	
	16	Oxalis perennans	✓			0.1	3	
	17	Ehrharta erecta			✓	0.1	10	
	18	Cyperus eragrostis			✓	0.1	3	
	19	Lotus sp. / Vicia sativa		✓		0.1	3	
	20	Mouse-ear chickweed Cerastium fontanum		✓		0.1	3	
	21	Verbena bonariensis		✓		0.1	3	
	22	Daucus carota		✓		0.1	3	
	23							
	24							
	25							
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 31/10/23	Richmond Bridge	Qdr	CP DP

GF	#	Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Eucalyptus saligna	✓			60	10	
	2	Cynodon dactylon	✓			60	2000	
	3	Bromus catharticus		✓		10	500	
	4	Taraxacum officinale		✓		0.1	5	
	5	Gamochaeta sp.		✓		0.1	10	
	6	Cenchrus clandestinus			✓	5	100	
	7	Ehrharta erecta			✓	1	50	
	8	Sporobolus africanus		✓		1	20	
	9	Hypochaeris radicata		✓		0.1	3	
	10	Trifolium repens		✓		1	20	
	11	Senecio madagascariensis			✓	0.1	1	
	12	Cyperus eragrostis			✓	0.1	5	
	13	Lamiaceae = Scutellaria racemosa		✓		0.1	3	*
	14	Alternanthera denticulata		✓		0.1	3	
	15	Cirsium vulgare		✓		0.1	5	
	16	Conyza bonariensis		✓		0.1	10	
	17	Plantago lanceolata		✓		0.1	10	
	18	Verbena bonariensis		✓		0.1	10	
	19	Rumex brownii	✓			0.1	3	
	20	Panicum sp.		✓		0.1	10	
	21	ex seedling		✓		0.1	1	ph
	22	Daucus carota		✓		0.1	3	
	23	Lolium perenne		✓		2	100	
	24	Sida rhombifolia		✓		0.1	3	
	25	All-seed Polycarpon tetraphyllum		✓		0.1	10	
	26	Mouse-ear chickweed Cerastium fontanum		✓		0.1	3	
	27	Soliva sessilis		✓		0.1	10	✓
	28	onion weed Nothoscordum borbonicum		✓		0.1	3	✓
	29	Acetosella - Turkey Rhubarb			✓	0.1	5	
	30	Oxalis corniculata		✓		0.1	20	
	31	Aster subulata		✓		0.1	10	
	32	Sonchus oleraceus		✓		0.1	3	
	33	daisy Calotis hispidula	✓			0.1	3	✓
	34	Eragrostis curvula			✓	2	20	
	35	Paspalum dilatatum			✓	0.1	10	
	36	Axonopus fissifolius			✓	1	20	
	37							
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3….. 1, 2, 3 ……. 10, 15, 20, 25 ……100% (foliage cover): ***Note:** 0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3…10, 20, 30….100, 200…1000…

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 1-11-2023	Richmond Bridge	Q05	GP DP

GF		Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Jacaranda		✓		10	2	
	2	Leopard Tree		✓		40	3	
	3	Cynodon dactylon	✓			20	1000	
	4	Bromus catharticus		✓		1	50	
	5	Poa annua		✓		3	200	
	6	Ehrharta erecta			✓	20	200	
	7	Mil-seed Polycarpon tetraphyllum		✓		0.1	40	
	8	Modiola caroliniana		✓		0.1	5	
	9	Conyza bonariensis		✓		0.1	10	
	10	Taraxacum officinale		✓		0.1	10	
	11	Soliva sessilis		✓		0.1	5	
	12	taper leaf grass = Paspalum bosc.		✓		0.1	10	
	13	Senecio madagascariensis			✓	0.1	5	
	14	Trifolium repens		✓		0.1	50	
	15	Aster subulata		✓		0.1	3	
	16	Cenchrus clandestinus			✓	5	100	
	17	Hypochaeris radicata		✓		0.1	5	
	18	Plantago lanceolata		✓		0.1	5	
	19	Cardamine sp.		✓		0.1	20	
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 1-11-2023	Richmond Bridge	006	GF DP

GF	Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1 Eragrostis curvula			✓	80	3000	
	2 Senecio madagascariensis			✓	3	100	
	3 Briza minor		✓		2	50	
	4 Juncus usitatus	✓			2	40	
	5 Wahlenbergia gracilis	✓			0.1	5	
	6 Axonopus fissifolius			✓	10	200	
	7 Hypochaeris radicata		✓		0.1	10	
	8 Paspalum dilatatum			✓	5	50	
	9 Lolium perenne		✓		5	100	
	10 Sorbaria sorbifolia		✓		0.1	10	
	11 Grammocheata sp.		✓		0.1	10	
	12 Cynodon dactylon	✓	✓		5	200	
	13 Plantago lanceolata		✓		0.1	20	
	14 Mouse-ear chickweed Cerastium fontanum		✓		0.1	5	
	15 Vicia ~~sativa~~ sativa		✓		0.1	3	
	16 Hypericum gramineum	.			0.1	3	✓
	17 Centella asiatica		✓		0.1	3	
	18 Oxalis perennans		✓		0.1	3	
	19						
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

PNV

400m² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 1-11-2023	Richmond Bridge	006 007	GP DP

GF		Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Corynocarpus laevigatus	✓			~~30~~ 15	~~40~~ 2	
	2	Grevillea robusta	✓			10	2	
	3	Morus alba		·	·	5	1	
	4	Ligustrum sinense			✓	50	8	
	5	Ligustrum lucidum			✓	50	8	
	6	Madeira vine Anredera cordifolia			✓	2	10	
	7	~~Senna pendula~~ Robinia pseudoacacia			✓	1	5	
	8	Cats claw Dolichandra unguis-cati			✓	2	10	
	9	Eucalyptus saligna	✓			15	2	
	10	Foxtail Palm Wodyetia bifurcata		✓		2	1	
	11	~~White Poplar~~ ? Populus nigra		✓		10	1	ph
	12	Araujia sericifera			✓	2	3	
	13	Sida rhombifolia		✓		1	30	
	14	Eragrostis curvula			✓	5	100	
	15	Cynodon dactylon	✓			~~50~~ 2	50	
	16	Passiflora ~~alberta~~		✓		1	3	
	17	Japanese honeysuckle Lonicera japonica			✓	3	10	
	18	Cestrum parqui			✓	1	5	
	19	Castor oil plant Ricinus communis		✓		1	3	
	20	Conyza floribunda			✓	5	100	
	21	Plantago lanceolata		✓		0.1	20	
	22	Ulmus sp.? Ulmus x hollandica		✓		1	5	ph
	23	Rumex crispus		✓		0.1	5	
	24	Conyza bonariensis		✓		0.1	10	
	25	Broom cartharticus		✓		1	200	
	26	Ehrharta erecta			✓	1	200	
	27	Lolium sp. perenne		✓		0.1	10	
	28	Sporobolus africanus		✓	✓	0.1	5	
	29	Chicorium endivum		✓		0.1	5	
	30	Brassica ~~rapa~~ Brassica nigra		✓		0.1	5	
	31	Syzygium sp. cultivar Syzigium oleosum	✓			2	1	
	32							
	33							
	34							
	35							
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	41							
	42							
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	44							
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	46							
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GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 1 11 2023	Richmond Bridge	Q08	GP DP

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Trifolium repens	E	10	2000	
2		Bromus carthartacus	E	30	1000	
3		Cirsium vulgare	E	2	20	
4		Sida rhombifolia	E	1	20	
5		Juncus sp. Juncus capillaceus		0.1	3	✓
6		Avena fatua	E	5	50	
7		Paspalum urvillei	E	10	200	
8		Plantago lanceolata	E	5	500	
9		Rumex crispus	E	1	20	
10		Salsify Tragopogon porrifolius	E	0.1	3	
11		Lolium perenne	E	1	20	
12		~~Anagallis~~ arvensis Lysimachia arvensis	E	0.1	10	
13		~~Brassica rapa~~ Brassica nigra	E	0.1	3	
14		Verbena bonariensis	E	0.1	3	
15		Hypochaeris radicata	E	0.1	10	
16		Taraxacum officinale	E	0.1	10	
17		Melia azedarach	N	0.1	3	
18		Cyperus eragrostis	HTE	0.1	5	
19		Ulmus sp.	E	1	3	ph.
20		Eragrostis curvula	HTE	2	5	
21		Modiola caroliniana	E	0.1	5	
22		Cynodon dactylon	N	5	400	
23		Araujia sericifera	HTE	0.1	3	
24		Lotus ≡ Vicia sativa	E	0.1	3	
25		Galium aparine	E	0.1	3	
26		Sonchus oleraceus	E	0.1	3	
27						
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

~~Pasture~~ Remnant

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 1 11 2023	Richmond Bridge	Q09	GP DP

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
1		Eucalyptus saligna	N	35	10	
2		Casuarina cunninghamiana Confirmed.	N	30	4	✓
3		Ligustrum sinense	HTE	5	10	
4		Solanum americanum	N	0.1	5	
5		Solanum nigrum	E	0.1	5	
6		Solanum linnaeanum	E	0.1	2	
7		Tradescantia fluminensis	HTE	30	500	
8		Gladiolus Ferdinandi	N	0.1	3	
9		Turkey Rhubarb Acetosa sagittata	HTE	1	20	
10		Bromus catharticus	E	1	20	
11		Ehrharta erecta	HTE	1	30	
12		Madeira vine Anredera cordifolia	HTE	2	40	
13		Ficus coronata	N	4	6	
14		~~Cats claw~~ Balloon vine Cardiospermum grandiflorum	HTE	20	200	
15		Ulmus sp. Ulmus x hollandica	E	2	10	
16		Setaria parviflora	E	0.1	5	
17		Gazania Gazania rigens	E	0.1	5	
18		pittosp exotic = Acer negundo	E	8	10	ph
19		Verbena bonariensis	E	0.1	10	
20		Queen Annes lace Ammi majus	E	0.1	3	
21		Callistemon salignus	N	1	3	
22		Ambrosia artemisiifolia	E	0.1	3	
23		Rumex crispus	E	0.1	5	
24		Conyza bonariensis	E	0.1	10	
25		Cestrum parqui	HTE	1	3	
26		Anredera floribunda	N	2	1	
27		Paspalum urvillei	E	0.1	3	
28		Solanum mauritianum	E	0.1	3	
29		Castor oil plant Ricinus communis	E	0.1	3	
30		Modiola caroliniana	E	0.1	10	
31		Oxalis corniculata	E	0.1	3	
32		~~Brassica rapa~~ Brassica nigra	E	0.1	1	
33		Chloris gayana	E	0.1	3	
34		Cynodon dactylon Confirmed.	N	3	100	✓
35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

Exotic

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 1 11 2023	Richmond Bridge	Q10	GP DP

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Ligustrum lucidum	HTE	80	200	
2		Ludwigia camara	HTE	3	10	
3		Cats claw creeper Dolichandra unguis-cati	HTE	10	50	
4		Bamboo grass? Austrostipa setacea		0.1	5	✓
5		Poplars Populus nigra	E	10	3	
6		Ehrharta erecta	HTE	2	100	
7		Acacia implexa	N	1	2	
8		Eragrostis curvula	HTE	10	200	
9		Balloon vine Cardiospermum grandiflorum	HTE	4	20	
10		Casuarina cunninghamiana	N	5	1	
11		Cenchrus clandestinus	HTE	5	100	
12		Avena fatua	E	0.1	5	
13		Salsify Tragopogon porrifolius	E	0.1	3	
14		Bidens pilosa	HTE	0.1	5	
15		Verbena bonariensis	E	0.1	5	
16		Conyza ~~sumatrensis~~ bonariensis	E	0.1	3	
17		Acacia parramattensis	N	2	1	
18		Sida rhombifolia	E	0.1	5	
19						
20						
21						
22						
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

Wetland

400 m² floristics plot:	Survey name	Plot identifier	Recorders	
Date 1 11 2023	Richmond Bridge	Q11	GP	DP

10x40

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	² Foliage cover	Abund-ance	Voucher
1	Grevillea robusta	N	20	10	
2	Bolboschoenus fluviatilis Confirmed.	N	40	2000	
3	Myriophyllum aquaticum	E	3	100	
4	Alocasia ferdinandi	N	0.1	3	
5	Cyperus Microtuberosum	N	0.1	3	
6	Juncus usitatus Confirmed.	N	10	200	✓
7	Persicaria decipiens Confirmed.	N	2	20	✓
8	Rumex crispus	E	1	20	
9	Salix Salix nigra	HTE	20	3	
10	Cyperus eragrostis	HTE	3	50	
11	Cynodon dactylon	N	1	20	
12	Blown grass Lachnagrostis filiformis	N	0.1	3	✓
13	~~Aquatica~~ Rorippa palustris Confirmed.	N	1	20	✓
14	Carex appressa	N	4	100	
15	Galium aparine	E	0.1	5	
16	Centella asiatica	E,N	0.1	5	
17	Lolium perenne	E	1	20	
18	Bromus catharticus	E	5	200	
19	Ulmus	E	4	10	
20	Ehrharta erecta	HTE	2	200	
21	Pinnate exotic 2 = Acer negundo	E	0.1	3	ph
22	pinnate exotic	E	0.1	1	
23	Sida rhombifolia	E	1	30	
24	Melaleuca linariifolia	N	8	3	
25	Conyza bonariensis	E	0.1	10	
26	Modiola caroliniana ? Confirmed.	E	0.1	10	✓
27	Verbena bonariensis	E	1	30	
28	Alisma plantago - aquatica Confirmed.	N	0.1	3	
29	Asteraceae? Aster subulatus	E	0.1	5	✓
30	Soliva sessilis	E	0.1	3	
31	Oxalis corniculata	E	0.1	5	
32	Ludwigia peploides	N	0.1	5	
33	soft forb Cerastium glomeratum		0.1	10	✓
34					
35					

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

² **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

Planted exotic

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 1 11 2023	Richmond Bridge	012	GP DP

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Populus nigra Confirmed.	E	60	3	✓
2		Avena fatua	E	20	300	
3		Ligustrum lucidum	HTE	0.1	3	
4		Plantago lanceolata	E	0.1	10	
5		Sida rhombifolia	E	0.1	3	
6		Juncus usitatus	N	0.1	5	
7		Lolium perenne	E			
8		Anagalis arvensis Lysimatchia arvensis	E	0.1	3	
9		Paspalum urvillei	E	5	20	
10		Eragrostis curvula				
11		Bromus catharticus	E			
12		Asteraceae (as per plot 11)	E	1	20	
13		Sida rhombifolia	E	0.1	10	
14		Panicum simile ?	E	5	50	✓
15		Confirmed. grass 2 Panicum miliaceum	E	30	500	✓
16		Verbena bonariensis	E	0.1	20	
17		Lomandra longifolia	N	3.	12	
18		onion weed	E	0.1	3	
19	Digitaria eriantha	~~Cynodon dactylon~~ Digitaria	HTE	30	1000	✓
20		~~Lotus~~ = Vicia sativa	E	0.1	5	
21		Modiola caroliniana	E	0.1	10	
22		Aronopus fissifolius	HTE	20	1000	
23		Taraxacum officinale	E	0.1	5	
24		Ligustrum sinense	HTE	0.1	5	
25		Arbujia sericifera	HTE	0.1	1	
26		Solanum nigrum	E	0.1	3	
27		Cirsium vulgare	E	0.1	5	
28		Melia azedarach	N	0.5	1	
29						
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

Planted exotic

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 2 11 2023	Richmond Bridge	Q13	GP DP

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
1		Pecan Carya illinoensis	E	60	3	
2		Lolium perenne	E	40	500	
3		Avena fatua	E	1	50	
4		Trifolium repens	E	4	50	
5		Medicago Medicago polymorpha	E	0.1	5	
6		Conyza bonariensis	E	0.1	50	
7	Aster subulatus	Asteraceae (see plot 011 sample)	E	0.1	10	
8		Aster subulata	E	0.1	20	
9		Cirsium vulgare	E	0.1	10	
10		Rumex crispus	E	0.1	20	
11		Cichorium endivum	E	2	30	
12		Bromus carthartacus	E	5	100	
13		Hypochaeris radicata	E	1	50	
14		Modiola carolinianum	E	0.1	10	
15		Plantago lanceolata	E	3	100	
16		Paspalum dilatatum	HTE	1	20	
17		Cynodon dactylon	N	5	2000	
18		Oxalis perennis	N	0.1	5	
19		Sonchus oleraceus	E	0.1	5	
20		Daucus carrota	E	0.1	100	
21		Japanese honeysuckle	HTE	1	10	
22		Typha orientalis	N	1	20	
23		Cyperus eragrostis	HTE	0.1	20	
24		Echinochaetha sp	E	0.1	10	
25		Ulmus sp. Ulmus x hollandica	E	0.1	3	
26		Lactuca serriolata	E	0.1	3	
27		Senecio madagascariensis	HTE	0.1	3	
28		Verbena bonariensis	E	0.1	10	
29		Blown grass - Lachnagrostis filiformis	N	1	20	ph
30		Ligustrum sinense	HTE	0.1	3	
31		~~Lotus~~ Vicia sativa	E	0.1	3	
32		Taraxacum officinale	E	0.1	5	
33		Stachys arvensis	E	0.1	3	
34		Poa annua	E	0.1	3	
35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date		Q14	

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Ulmus sp Ulmus x hollandica	E	5	4	
2		Ludwidia peploides	N	10	200	
3		Bolboschoenus fluviatilis	N	20	2000	
4		Persicaria ~~orientalis~~ lapathifolia	E	0.1	~~10~~	✓
5		Turkey rhubarb	HTE	5	100	
6		Cicerium erdium	E	1	20	
7		branching forb Ranunculus sceleratus	E	3	50	✓
8		Fimbristylis ? dichotoma		2	200	✓
9		Avena fatua Confirmed	E	4	100	✓
10		low forb ~~Lotus~~ Calotis hispidula		0.1	3	✓
11		Gamochaeta sp	E	0.1	10	
12		Echerta erecta	HTE	1	100	
13		Blown grass Lachnagrostis filiformis	E	0.1	10	
14		Conyza bonariensis	E	1	50	
15		Daucus carrota	E	0.1	5	
16		Sonchus oleraceus	E	0.1	10	
17		Asteraceae (Q11 sample) Aster subulatus	E	1	20	
18		Persicaria decipiens Confirmed	N	0.1	10	✓
19		Cassytha? sp orange, smooth Cassytha glabella		0.1	3	✓
20		Ranunculus sceleratus		0.1	5	✓
21		Alternanthera denticulata Confirmed	N?	3	500	✓
22		~~Lotus~~ Vicia sativa Confirmed	E	0.1	3	✓
23		Phalaris aquatica	E	1	20	
24	Lysimachia	~~Anagallis~~ arvensis	E	0.1	3	
25		Lactuca serriolata	E	0.1	3	
26		~~Cenchrus~~ Cirsium vulgare	E	0.1	5	
27		Rorippa palustris	N	0.1	5	
28		Typha orientalis	N	3	50	
29		Cyperus dactylon	N	2	100	
30		Verbena bonariensis	E	0.1	3	
31		Solanum americanum	N	0.1	10	
32		Solanum mauritianum	E	0.1	3	
33						
34						
35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

PJW

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 2 11 2023	Richmond Bridge	Q15	GP DP

10x40 / 10x100 m

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Casuarina glauca	N	60	15	
2		Balloon vine	HTE	30	100	
3		Araujia sericifera	HTE	0.1	5	
4		Ehrharta erecta	HTE	5	200	
5		Ligustrum lucidum	HTE	1	10	
6		Cestrum parqui	HTE	2	10	
7		Bromus catharticus	E	5	500	
8		Ulmus sp Ulmus x hollandia	E	0.1	3	
9		Cenchrus clandestinus	E	1	20	
10		Solanum mauritianum	E	1	10	
11		Schinus molle	E	1	3	
12		Juncus sp Juncus usiatus		0.1	3	✓
13		Tradescantia fluminensis	HTE	2	50	
14		Plantago lanceolata	E	0.1	20	
15		Rumex crispus	E	0.1	10	
16		Cirsium vulgare	HTE	10	2000	
17		grass 2 Panicum miliaceum	E	1	20	
18		Verbena bonariensis	E	1	20	
19		Galium aparine	E	0.1	3	
20		Panicum sp	E	2	20	
21	Confirmed	Alternanthera denticulata	E	0.1	10	✓
22		Solanum linnaeanum	E	0.1	10	
23		Cynodon dactylon	N	8	2000	
24	Confirmed	Convolvulus erubescens	E	PJW 2	30	✓
25		Sonchus oleraceus	E	0.1	3	
26		Chloris gayana	HTE	5	200	
27		Sida rhombifolia	E	0.1	10	
28		Brassica ~~rapa~~ Brassica fruticulosa	E	0.1	3	✓
29		Asparagus asparagoides	HTE	0.1	1	
30						
31						
32						
33						
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1,000, 2,000, 3,000 ... (as integer values).

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	IIII
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	~~HHT~~
	20-29 cm	
	10-19 cm	III
	5-9 cm	IIII
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	~~HHT~~ ~~HHT~~ III

Count of HBTs†
I
II

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m)	Tally	TOTAL LENGTH (m)
Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	O	Om

1 m² sub PLOT

	Litter cover (%)				
Subplot	85	80	90	0	50
Average	61				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter.** Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 01 **Date:** 30/10/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	II
	50+ cm	III
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	I~~IIII~~
	10-19 cm	~~IIII~~ IIII
	5-9 cm	~~IIII~~
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
II

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	**Tally**	**TOTAL LENGTH (m)**
	21, 27, 34, 36, 38, 68, 71, 78	78m

1 m² sub PLOT

	Litter cover (%)				
Subplot	95	60	30	80	75
Average	68				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 02 **Date:** 30/10/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	0
	50+ cm	"
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	"
	20-29 cm	"
	10-19 cm	"
	5-9 cm	"
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	"

Count of HBTs†
0
"
"
"
"
"
"

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	0	0m

1 m² sub PLOT

	Litter cover (%)				
Subplot	95	90	100	95	100
Average	96				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 03 **Date:** 31 / 10 / 2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	1
	50+ cm	𝍸 II
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	𝍸
	20-29 cm	IIII
	10-19 cm	
	5-9 cm	
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
1
1

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	0	0m

1 m² sub PLOT

	Litter cover (%)				
Subplot	100	95	97	95	95
Average	96				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 04 **Date:** 31/10/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	n/a
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	0	0

1 m² sub PLOT

	Litter cover (%)				
Subplot	65	20	95	100	0
Average	56				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 05 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	n/a
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	n/a	n/a

1 m² sub PLOT

	Litter cover (%)				
Subplot	100	95	100	95	100
Average	98				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter.** Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 06 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	11
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	1111
	20-29 cm	~~1111~~ 1
	10-19 cm	~~1111~~ 1111
	5-9 cm	111
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	2, 6, 7, 29, 32, 36, 156, 158, 173,	173m

1 m² sub PLOT

	Litter cover (%)				
Subplot	~~100~~	100	100	100	70
Average	94				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 07 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	1
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m)	Tally	TOTAL LENGTH (m)
Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	n/a	n/a

1 m² sub PLOT

	Litter cover (%)				
Subplot	95	100	100	65	85
Average	89				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 08 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	11
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	𝍸 1111
	20-29 cm	𝍸 𝍸 1
	10-19 cm	𝍸 𝍸 𝍸 1
	5-9 cm	11
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	𝍸

Count of HBTs†
1

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	12, 22, 25, 48, 50, 54, 67	67m

1 m² sub PLOT

	Litter cover (%)				
Subplot	80	45	60	65	100
Average	70				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 09 **Date:** 01 / 11 / 2023 **Recorder:** O. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	n/a
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	1, 4, 5, 6, 8	8

1 m² sub PLOT

	Litter cover (%)				
Subplot	95	60	100	20	95
Average	74				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 10 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	1
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	III
	20-29 cm	IIII III
	10-19 cm	IIII
	5-9 cm	II
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	~~10 8, II~~ 110

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m)	Tally	TOTAL LENGTH (m)
Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	3, 8, 9, 10, 30, 31, 33, 38, 39	39

1 m² sub PLOT

	Litter cover (%)				
Subplot	90	50	30	30	75
Average	55				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 11 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	III
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	I

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m)	Tally	TOTAL LENGTH (m)
Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	2, 8, 10	10

1 m² sub PLOT

	Litter cover (%)				
Subplot	70	90	100	75	100
Average	87				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 12 **Date:** 01/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	n/a
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m)	Tally	TOTAL LENGTH (m)
Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	0	0

1 m² sub PLOT

	Litter cover (%)				
Subplot	50	95	80	95	80
Average	80				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 13 **Date:** 02/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	n/a
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	
	20-29 cm	
	10-19 cm	
	5-9 cm	
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m)	Tally	TOTAL LENGTH (m)
Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	3	3

1 m² sub PLOT

	Litter cover (%)				
Subplot	5	55	5	95	70
Average	46				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 14 **Date:** 02/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

1,000 m² PLOT

Tree Stem Size Class*		Trees^
Count of Large Trees Record DBH of each tree at 1.3 m from ground.	80+ cm	
	50+ cm	
All other Trees: Only record ***presence or absence*** of trees in these stem size classes. Record DBH of each tree at 1.3 m from ground.	30-49 cm	𝍸 𝍸 ||||
	20-29 cm	𝍸 𝍸 𝍸 𝍸
	10-19 cm	𝍸 𝍸 ||||
	5-9 cm	𝍸 𝍸 |||
Presence or absence of **Regeneration#** Maximum stem diameter of <5 cm regardless of height.	<5 cm	𝍸 𝍸 | 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸

Count of HBTs†
n/a

*Living trees only; for **multi-stemmed trees**, only largest stem is counted or recorded as present;

#Record presence of regeneration for any tree with a maximum stem diameter of <5 cm, regardless of height (i.e., record presence of regeneration if sapling or seedings that are <1.3 m heigh and have DBH <5 cm).

^Includes species classified as Trees under the BAM Growth Form Table.

†Count of **hollow-bearing *trees*** and ***shrubs***; includes living and dead; record by stem size class.

Length of logs (m) Fallen logs = >10 cm diameter, that is dead and entirely or partly on the ground within the 1,000 m² plot. Only the length of log within the plot is recorded.	Tally	TOTAL LENGTH (m)
	6	6

1 m² sub PLOT

	Litter cover (%)				
Subplot	95	95	50	100	2
Average	70				

Litter includes leaves, seeds, twigs, branchlets and branches **less than 10 cm diameter**. Include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as foliage cover, regardless of whether it appears alive or dead.

Quadrat Number: 15 **Date:** 02/11/2023 **Recorder:** D. PLUNKETT

Property Name or Project Name: RICHMOND BRIDGE

☑ Both Start and End points collected on GPS

☑ Start and End locations are approximately 50 m apart on GPS

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00044696/BAAS19010/23/00044697

Proposal Name
Richmond Bridge

BAM data last updated *
14/03/2024

Assessor Name
George Thomas Plunkett

Assessor Number
BAAS19010

BAM Data version *
67

Proponent Names

Report Created
05/09/2024

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Part 5 Activities

Date Finalised
To be finalised

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	3320-Cumberland Shale Plains Woodland

Species
Lathamus discolor / Swift Parrot

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

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

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3320-Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.3	9	0	9
4025-Cumberland Red Gum Riverflat Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	1.4	22	0	22
3975-Southern Lower Floodplain Freshwater Wetland	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.6	0	16	16

3320-Cumberland Shale Plains Woodland

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 3319, 3320	-	3320_low-moderate	Yes	9	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3975-Southern Lower Floodplain Freshwater Wetland

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 1738, 3958, 3959, 3962, 3964, 3965, 3967, 3971, 3973, 3975, 3976	-	3975_low-moderate	No	16	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
4025-Cumberland Red Gum Riverflat Forest	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 3145, 3181, 3185, 3188, 3192, 3258, 3328, 4024, 4025, 4039, 4041, 4058, 4138	-	4025_low-moderate	Yes	22	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Lathamus discolor / Swift Parrot	**4025_low-moderate**	0.9	23.00
Myotis macropus / Southern Myotis	**4025_low-moderate, 3975_low-moderate**	1.9	38.00

Credit Retirement Options

Like-for-like credit retirement options

Lathamus discolor / Swift Parrot	Spp	IBRA subregion
	Lathamus discolor / Swift Parrot	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00044696/BAAS19010/23/00044697

Proposal Name
Richmond Bridge

BAM data last updated *
14/03/2024

Assessor Name
George Thomas Plunkett

Assessor Number
BAAS19010

BAM Data version *
67

Proponent Name(s)

Report Created
05/09/2024

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Part 5 Activities

Date Finalised
To be finalised

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	3320-Cumberland Shale Plains Woodland

Species
Lathamus discolor / Swift Parrot

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

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

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3320-Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.3	9	0	9.00
4025-Cumberland Red Gum Riverflat Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	1.4	22	0	22.00
3975-Southern Lower Floodplain Freshwater Wetland	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.6	0	16	16.00

3320-Cumberland Shale Plains Woodland

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 3319, 3320	-	3320_low-moderate	Yes	9	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3975-Southern Lower Floodplain Freshwater Wetland	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 1738, 3958, 3959, 3962, 3964, 3965, 3967, 3971, 3973, 3975, 3976	-	3975_low-moderate	No	16	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Freshwater Wetlands	Tier 1	3975_low-moderate	No	16	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
4025-Cumberland Red Gum Riverflat Forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 3145, 3181, 3185, 3188, 3192, 3258, 3328, 4024, 4025, 4039, 4041, 4058, 4138	-	4025_low-moderate	Yes	22	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 3 or higher threat status	4025_low-moderate	Yes (including artificial)	22	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Lathamus discolor / Swift Parrot	**4025_low-moderate**	0.9	23.00
Myotis macropus / Southern Myotis	**4025_low-moderate, 3975_low-moderate**	1.9	38.00

Credit Retirement Options

Like-for-like options

Lathamus discolor/ Swift Parrot	Spp	IBRA region

	Lathamus discolor/Swift Parrot		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Endangered	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp		IBRA region
	Myotis macropus/Southern Myotis		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.