APPENDIX

I

BIODIVERSITY ASSESSMENT REPORT

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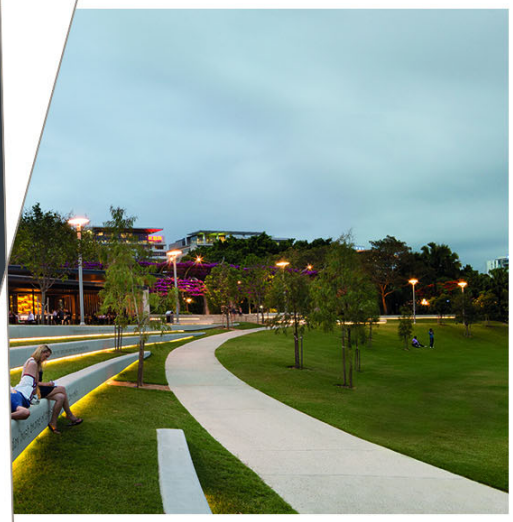
Biodiversity Assessment Report

Dunheved Road Upgrade

80021086



Prepared for
Penrith City Council

3 August 2022

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Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
V01	29/03/2022	First draft for internal review	Adriana Corona Mothe	Craig Blount
RevA	5/04/2022	Final for REF	Adriana Corona Mothe	Craig Blount
RevB	1/08/2022	Updated Final for REF	Adriana Corona Mothe	Craig Blount
RevC	3/08/2022	Updated Final for REF	Adriana Corona Mothe	Craig Blount

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1 Introduction

1.1 Background

Cardno, now Stantec, was engaged by Penrith City Council (Council) to prepare a Review of Environmental Factors (REF) to assess the potential ecological impacts associated with the upgrade of a 4.2 km stretch of Dunheved Road (the project), a regional road in western Sydney (Penrith City LGA) (see **Figure 1-1**). This includes widening of Dunheved Road from two lanes to four lanes and a medium strip. Up to 12 intersections will be upgraded with turning lanes and improved signalisation, as well as three roundabouts on adjacent local roads.

The Biodiversity Assessment Report (BAR) will support the REF and specifically considers:

- The significance of any impact on any threatened species, ecological communities or endangered populations listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and/or NSW *Fisheries Management Act 1994* (FM Act), and therefore whether a Species Impact Statement or a Biodiversity Development Assessment Report is required; and/or
- The potential for significant impacts on Matters of National Environmental Significance (or Commonwealth land) subject to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the need to make a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) or whether assessment and approval is required under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

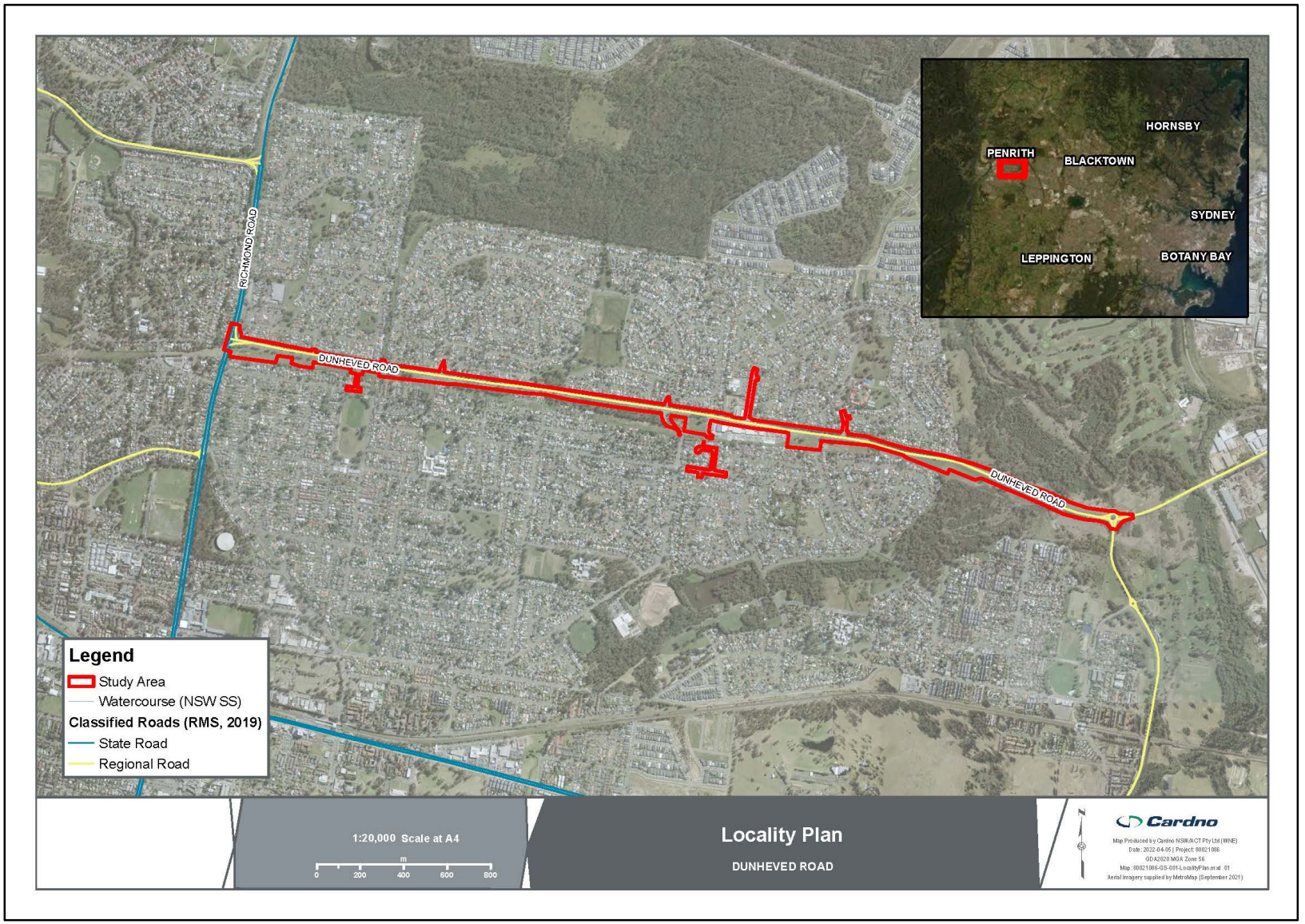

Figure 1-1 Location of the proposed Study Area

1.2 Study Area Particulars

The Study Area is approximately 18.26 ha, including the 4 kms of Dunheved Road, Penrith NSW and its surrounds. The Study Area extends from Richmond Road to the roundabout at intersection of Dunheved Road – Christie Street and Werrington Road. The Study Area and Site are shown in **Figure 1-1**. **Table 1-1** provides other particulars of the Study Area.

Table 1-1 Study Area Particulars

Properties	Site Particulars
Lot/DP	Several Lot / DP along Dunheved Road
Address	Dunheved Road extending from Richmond Road to the intersection of Dunheved Road – Christie Street and Werrington Road, which includes the suburbs of Penrith 2750, Cambridge Gardens 2747, Cambridge Park 2747, Werrington Downs 2747, Werrington County 2747 and Werrington 2747.
Location	The Study Area is located approximately 1.8 km north from Kingswood train station and Penrith CBD area.
Study Area	Approximately 18.26 ha Construction Boundary is 18.14 ha. The Construction Boundary is the impact area where the road design, construction works area and laydown areas (e.g. stockpiling) will occur.
Site	The Dunheved Road upgrade will be located on both sides of the current Dunheved Road. A small portion of the Site will be located on Orleton Place and Rugby Street. Three roundabouts are proposed at: ▪ Intersection between Tasman Street and Eton Road, Cambridge Park ▪ Intersection between Henry Lawson Avenue and Madigan Drive, Werrington County ▪ Intersection between John Batman Avenue and Ovens Drive, Werrington County
LGA	Penrith City Council
Zoning	In accordance with Penrith LEP 2010, the Study Area is mapped as: ▪ R2 (Low Density Residential) ▪ R3 (Medium Density Residential) ▪ RE1 (Public Recreation) ▪ B2 (Local Centre) ▪ E2 (Environmental Conservation) In accordance with the LEP's Scenic and Landscape Values Map, the eastern portion of the Site is mapped as "land with Scenic and Landscape Values". The same area is mapped as 'Flood planning area' in the Flood Planning Land Map. The Land Reservation Acquisition map indicates that a lot is mapped as Classified Road (SP2).
IBRA Bioregion	Sydney Basin (SYB)
IBRA Sub-region	Cumberland (SYB08)
Mitchell Landscape	The Study Area is located within the following Mitchell Landscapes: ▪ Cumberland Plain (Cpl) of the SB Cumberland Landscape ecosystem meso grouping (estimated 89 % cleared). ▪ Hawkesbury – Nepean Channels and Floodplains (Hac) of the SB Cumberland Landscape ecosystem meso grouping (estimated 79 % cleared).
Geology	The Sydney 1:100 000 Geological series sheet SH/55-15 map Indicates that the Study Area includes shale, carbonaceous claystone, laminite, fine to medium-grained lithic sandstone, road coal and tuff of the Wianamatta Group (Rwb) and fine-grained sand, silt and clay (Qal).
Koala Habitat Protection SEPP	Penrith City Council is not an LGA listed under Schedule 1 of the State Environmental Planning Policy (Koala Habitat Protection) 2021. Therefore, the Koala SEPP 2021 does not apply to the Study Area.
NSW WeedWise Local Area	The Penrith LGA is part of the Greater Sydney Local Land Services Region.

Properties	Site Particulars
Groundwater Dependent Ecosystems	The Bureau of Meteorology groundwater dependent ecosystem (GDE) atlas (BoM 2021b) indicates that: ▪ South Creek, adjacent to the Study Area is mapped as an aquatic GDE. It is part of a river ecosystem that includes tributaries that flow through the Study Area. ▪ Two vegetation types mapped as terrestrial GDE occur within the Study Area: – Cumberland Shale Plains Woodland vegetation is mapped on the southern part of Dunheved Road, a patch of vegetation between Hollier Street and Francis Street, and in open space on the eastern and of the Study Area at and near the riparian corridor associated to Werrington Creek and South Creek. – Cumberland River Flat Forest in a small patch adjacent to Werrington Creek and on the southern side of Dunheved Road. ▪ The entire Study Area is mapped as a being underlain by the subterranean GDEs 'Greater Metropolitan Region Groundwater' and 'Sydney Basin Central', a water sharing plan and water source type of GDE.
Aquatic Habitat	Werrington Creek is located on the eastern portion of the Study Area, desktop review indicated the following: ▪ Werrington Creek is a third order stream tributary of South Creek, part of the Hawkesbury River system. ▪ The condition of Werrington Creek with regards to its condition as habitat for freshwater fish community is not known, however, the condition of South Creek is fair. ▪ Werrington Creek and South Creek are mapped as Key Fish Habitat. However, they are not known habitat of threatened fish species. The nearest threatened fish species habitat is the Nepean River, located at approximately 2.8km west from the Study Area and mapped a habitat for Macquarie Perch (*Macquaria australasica*) and Sydney Hawk Dragonfly (*Austrocordulia leonardi*). A small drain line connects to a culvert which flows under Dunheved Rd and eventually into South Creek. It has no suitable habitat for protected or threatened aquatic species and would only flow after rain.
Areas of Outstanding Biodiversity Value	Areas of Outstanding Biodiversity Value (AOBV) are declared by the NSW Minister for the Environment and under the BC Act. The register of AOBV indicates that at the time of assessment (23 July 2021) There are four declared AOBV: ▪ Gould's Petrel – Critical Habitat Declaration; ▪ Little penguin population in Sydney's North Harbour – Critical Habitat Declaration; ▪ Mitchell's Rainforest Snail in Stotts Island Nature Reserve – Critical Habitat Declaration; and ▪ Wollemi Pine – Critical Habitat Declaration. The proposed project is not located near or at any of the AOBV. Therefore, it is considered that the proposed project will not result on any direct or indirect impacts on AOBV.
Wildlife Connectivity	The eastern portion of the Study Area has limited to moderate connectivity value. Limited connectivity value occurs in cleared areas, whereas moderate value is present in vegetated riparian corridor and patches of vegetation. It is noted that South Creek and its riparian corridor are included in the 'Green Grid Priority Corridor' part of the Greater Penrith to Eastern Creek Growth Area in the Western District proposed as part of the Metropolis of Three Cities plan. Werrington Creek and its riparian corridor are not part of the proposed 'Green Grid Priority Corridor' but their proximity to South Creek provides opportunities to enhance future wildlife corridor by incorporating remnants of Werrington Creeks riparian corridor into future green spaces.
Locality	The Study Areas is located within a predominantly residential landscape with open space which appear to have undergone historical disturbance, it is surrounded by: ▪ Northern side of Dunheved Road: – Road reserve, small roads (e.g. Lockyer Avenue), then residential properties occur along most part of the northern boundary of Dunheved Road. – Intersection with small streets occur, including Trinity Drive, Greenbank Drive, Brookfield Avenue, Henry Lawson Avenue, Hacking Avenue, Fawkener Place and John Batman Avenue. – Open space occurs at the eastern end of the Study Area, in Lot 33 DP579821, Lot 1 DP19910, Lot 3 DP701601

Properties	Site Particulars
	– Open space part of Jim Anderson Park occurs between Valleyview Crescent and Brookfield Avenue. – Open space is present in Lot 32 DP576288 and part of Lot 1 DP1218801 at the corner of Dunheved Road and Henry Lawson Avenue. ▪ Southern side of Dunheved Road: – Cambridge Park occurs at the corner of Richmond Road and Dunheved Road. – Open space extends all along the southern part of Dunheved Road, with exception of a section between Lavin Crescent where commercial shopping centre and petrol station occur. – Open space occurs at the eastern end of the Study Area, in Lot 2, DP 719910, Lot 1 DP701601 and Lot10 DP749661. ▪ Werrington Creek runs south-west to north-east crossing Dunheved Road at approximately 260m west of the Dunheved Road – Christie Street – Werrington Road roundabout. Werrington Creek is a third order stream tributary of South Creek, part of the Hawkesbury River system.

*as shown in SixMaps (https://maps.six.nsw.gov.au/)

2 Methodology

2.1 Desktop Review

The following databases and maps were reviewed for biodiversity attributes within the Study Locality (i.e. a 5 km radius around the Study Area):

> NSW BioNet (NSW OEH, 2022a);
> Threatened Biodiversity Data Collection (NSW DPIE, 2022);
> Fish communities and threatened species distribution of NSW (NSW DPI, 2016);
> Threatened species lists (NSW DPI, 2022a);
> Listed Protected Fish Species (NSW DPI, 2022a);
> The Native Vegetation of the Sydney Metropolitan Area – Version 3.1 VIS_ID 4207 (NSW DPIE, 2013, Tozer 2010);
> Mapping the habitats of NSW estuaries (Creese, Glasby, West, & Callen, 2009);
> Protected Matters Search Tool (PMST) (DoEE, 2021);
> Atlas of Living Australia (Atlas of Living Australia, 2022);
> NSW WeedWise (NSW DPI, 2022);
> NSW Aquatic Pest and Disease Distribution (NSW DPI, 2019c); and
> Map of marine pests in Australia (Australian Government, 2019).

A minimum search area of 5 km was undertaken for the majority of database and map searches.

The desktop review also identified any sensitive ecological sites (e.g. Commonwealth Marine Parks, NSW, Marine Parks, NSW Aquatic Reserves, wetlands) and other areas protected by Commonwealth, State and local environmental planning instruments (EPIs) due to their ecological significance. Sources included:

> Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act;
> Critical habitat listed under the FM Act;
> Critical habitat listed under the EPBC Act;
> Key Fish Habitat (KFH) maps (NSW DPI, 2019e);
> Australian Marine Parks map (Parks Australia, 2019);
> NSW National Parks map (NSW National Parks and Wildlife Service, 2019);

> Australian Ramsar Wetlands map (DoEE, 2019b);

2.2 Site Inspection

Four site inspections were undertaken as follows:

> Site inspection 1 (23 - 24 September 2021). Details include:
  - The biodiversity Study Area was 18.26 ha and included a 20 m buffer around the project footprint.
  - Vegetation mapping as per existing government databases were used as base to ground-truth vegetation within the Study Area. The existing vegetation map included the Vegetation Map – Cumberland Plain West (VIS 4207) map. Prior to site inspection, the existing vegetation map and Study Area boundary were created in ArcMap 10.7 and in the ESRI app Collector into a hand-held tablet.
  - A random meander transect (RMT) across the Study Area to verify:
    - Presence of native vegetation as Plant Community Types (PCTs). Current extent of PCTs were mapped in Collector using a hand-held tablet;
    - Identifying fauna habitat features and collecting opportunistic sightings of flora and fauna. Where suitable habitat occurred, searches for threatened flora and the Cumberland Plain Land Snail were undertaken;
    - Assessing presence and condition of aquatic habitat features. A qualitative habitat assessment was undertaken where Dunheved Road crosses Werrington Creek.
> Site Inspection 2 (12 January 2022). Undertook two detailed vegetation plots (BAM plots) in Cumberland Plain Woodland within the Study Area. Vegetation plot datasheets are provided in **Appendix C**.
> Site Inspection 3 (23 February 2022. Undertook targeted surveys for Cumberland Plain Land Snail (CPLS) in selected areas.
> Site Inspection 4 (18 March 2022). Ground-truthed additional area for Construction Boundary.
> Initial Surveys (26, 27 and 30 May 2022). BAM plots (see **Appendix C**) and bird surveys.

Table 2-1 provides a summary of environmental conditions on the field days. Overall, the days were clear, sunny with sporadic windy conditions.

Table 2-1 Weather Conditions During Surveys

Date	Temperature (°C) *		Rainfall*	Other observations on-site
	Minimum	Maximum	(mm)	
23/09/2021	6.4	28.3	0	Sunny, clear
24/09/2021	7.4	27.9	0	Clear, windy
12/01/2022	21.6	26.6	0	Overcast, humid
23/02/2022	19.7	27.9	-*	Overcast, rainy
18/03/2022	19.5	30.2	0.2	Overcast to sunny, humid
26/05/2022	10.8	21.8	0	Overcast to sunny, early morning fog
27/05/2022	9.3	21.7	0	Overcast to sunny, early morning fog
30/05/2022	3.8	15.8	3.8	Overcast, rainy.

**Data as per Bureau of Meteorology (BoM) nearest meteorological station (Station 067113 Penrith Lakes AWS NSW) at http://www.bom.gov.au/climate/dwo/IDCJDW2111.latest.shtml*

**Data not provided in BOM*

3 Existing Environment

3.1 Terrestrial Environment

3.1.1 Existing vegetation

The Study Area consisted predominantly of cleared land, roads and road reserves with exotics. Native vegetation included planted natives (e.g. in road reserves), remnant native vegetation and paddock trees. Native vegetation recorded consisted of two plat community types (PCTs), PCT 849 and PCT 835 in differing conditions (see **Table 3-1**). Ground-truthed vegetation is shown in Error! Reference source not found. to Error! Reference source not found..

Table 3-1 Vegetation Communities within the Study Area

PCT ID	PCT Name	Condition	Description	Construction Boundary Area (ha)
Native Vegetation				
849	Cumberland Shale Plains Woodland	Moderate	Open woodland with canopy and ground layer, sparse shrubs. Species present included *Eucalyptus molucana*, *Eucalyptus* sp. (regrowth stems <10 cm DBH[1]), *Eragrostis* sp., *Bursaria spinosa*, *Exocarpos curpressiformis*, *Dodonaea viscosa*, *Dillwynia sieaberi*, *Themeda triandra*, *Diannella caerulea*, *Lomandra multiflora* and *Dichondra repens*. Exotic species present included *Araujia cericifera*, *Asparagus aetiopicus*, *Plantago lanceolata*, *Sida rhombifolia*, *Bidens pilosa*, *Senna pendula*, *Bryophyllum delagoense*, *Asparagus asparagoides* and *Verbena boniariensis*.	0.01
849	Cumberland Shale Plains Woodland	Low - Moderate	Open woodland with canopy and ground cover composition similar to above, however, the shrub component was dense and mainly consisting of *Bursaria*.	0.14
849	Cumberland Shale Plains Woodland	Low	Open woodland with remnant canopy and dominance of exotic species in the ground cover. African Lovegrass (*Eragrostis curvula*) dominates the ground cover.	0.47
849	Remnant Trees - Cumberland Shale Plains Woodland	Remnant Trees	Patch of remnant trees were areas located in cleared land with no native shrub and ground layer, but with native trees whose canopies were touching or were within 50m of each other. Native trees which are part of the Cumberland Shale Plains Woodland included *Eucalyptus molucana*, *Eucalyptus tereticornis* and *Angophora floribunda*.	0.72
835	Cumberland Riverflat Forest	Low - Moderate	Open forest with *Angophora floribunda* as the main canopy component, incidences of *Eucalyptus molucana* and *Eucalyptus tereticornis*. Native shrub layer included Bursaria spinosa, the native ground layer was sparse including *Dichondra repens*. Exotics were dominant in the shrub and ground layer, species included *Ligustrum sinense*, *Tradescantia fluminensis*, *Sida rhombifolia*, *Asparagus asparagoides, Eragrostis* sp *and Senna pendula.*	0.01

[1] DBH = Diameter at Breast Height (cm) measured at 1.3m above ground level.

PCT ID	PCT Name	Condition	Description	Construction Boundary Area (ha)
835	Cumberland Riverflat Forest	Very Low	The vegetation zone had a sparse native canopy and shrub layer, including *Angophora floribunda*, *E. tereticornis* and *Acacia parramattensis*. The native groundcover consisted of occasional occurrence of *Dichondra repens*. Exotic species included Ligustrum lucidum (shrub/canopy), *Verbena boniariensis, Asparagus asparagoides, Plantago lanceolata* and *Ehrharta erecta*. A highly degraded area along the riparian corridor of Werrington Creek has some elements of PCT 835, including Cassuarinas, with dominance of exotic species.	0.21
-	Native regrowth with exotics	NA	A small patch of exotic dominated vegetation with native shrub with Eucalypt sp. regrowth (small trees with DBH <10cm diameter). The native component included *Melaleuca decora* and *Pandorea pandorana*. Exotic species included *Eragrostis curvula, Ehrharta erecta*, *Tradescantia fluminensis*, *Jasmin* sp., *Arujia cericifera*, *Plantago lanceolata* and *Taraxacum officinale*.	0.47
-	Patch of remnant trees	NA	Patch of remnant trees were areas located in cleared land with no native shrub and ground layer, but with native trees whose canopies were touching or were within 50m of each other. Native trees included *Angophora floribunda*.	
-	Paddock Trees	NA	Paddock trees were native gum trees located in otherwise cleared land (i.e. exotic lawn) which were isolated. This category also included road site trees. Species included *A. floribunda* and *Eucalyptus* sp.	
-	Planted natives	NA	Planted natives were observed on road reserves, road mid-lanes and landscaped areas within the Study Area. The most widely planted species were *Melaleuca* spp., *Callistemon citrinus*, and *Eucalyptus* spp. Other species included *Acacia* spp., *Bursaria spinosa*, *Jacaranda mimosifolia*, *Lomandra multiflora*, *Dianella caerulea* and *Cassuarina glauca*. These areas have some level of exotic invasion from low to high weediness. Exotic species included *Bidens pilosa*, *Conyza boniarensis*, *Asparagus aethiopicus*, *Plantago lanceolata*, *Taraxacum officinale*, *Eragrostis curvula*, *Ehrharta erecta*, *Bromus catharticus* and *Chloris* sp.	3.07
Miscellaneous vegetation / areas				
	Cleared Land / Exotics	NA	Consisted mainly of maintained lawns with exotic herbs. This category also includes drain lines as these areas predominantly consisted of exotic species.	12.97
	Blackberry Patch	NA	A patch of Blackberry (*Rubus fruticosus* sp. aggr.)	X
	Built	NA	Roads, culverts, commercial/residential structures	A

Notes: NA = Not applicable; X = within 10m outside of the Study Area; A – included in Cleared Land / Exotics

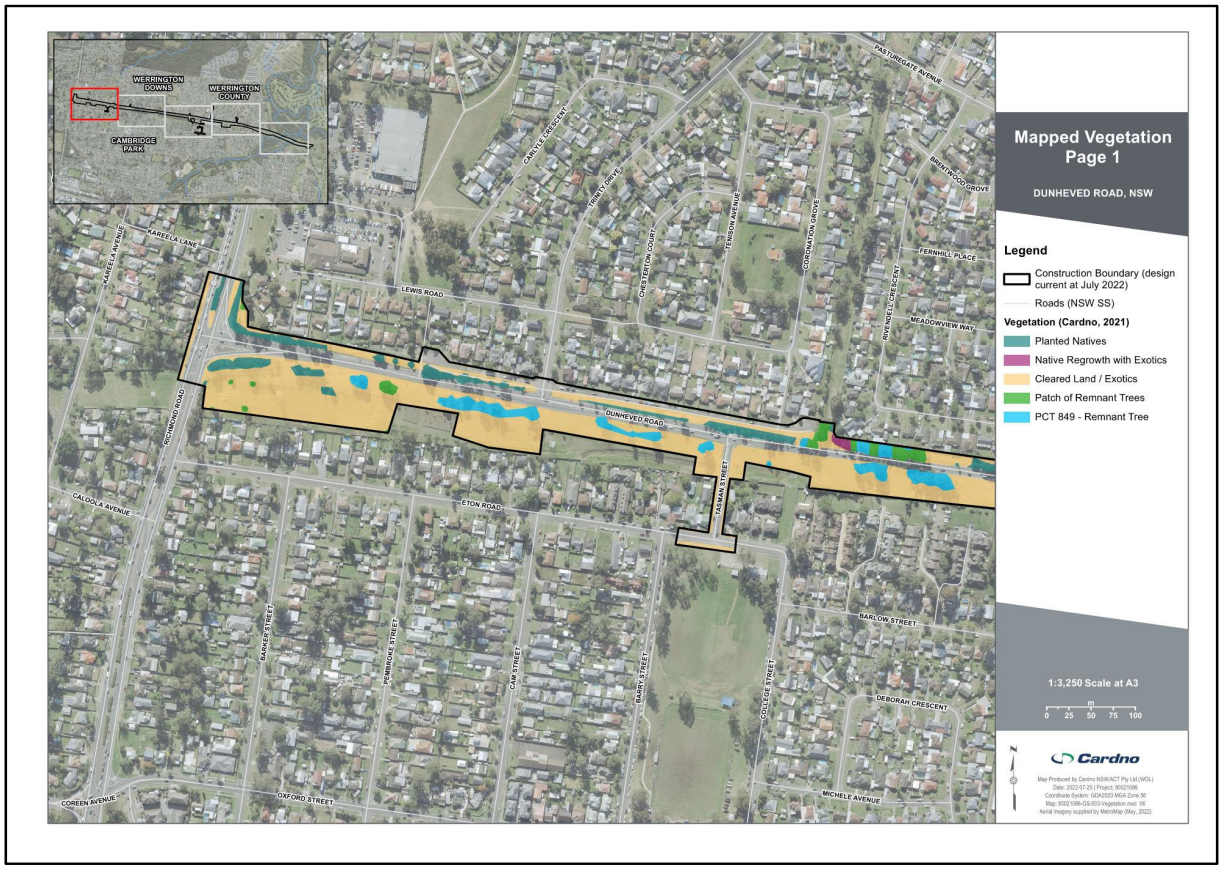

Figure 3-1 Study Area section 1 – Ground-truthed Vegetation

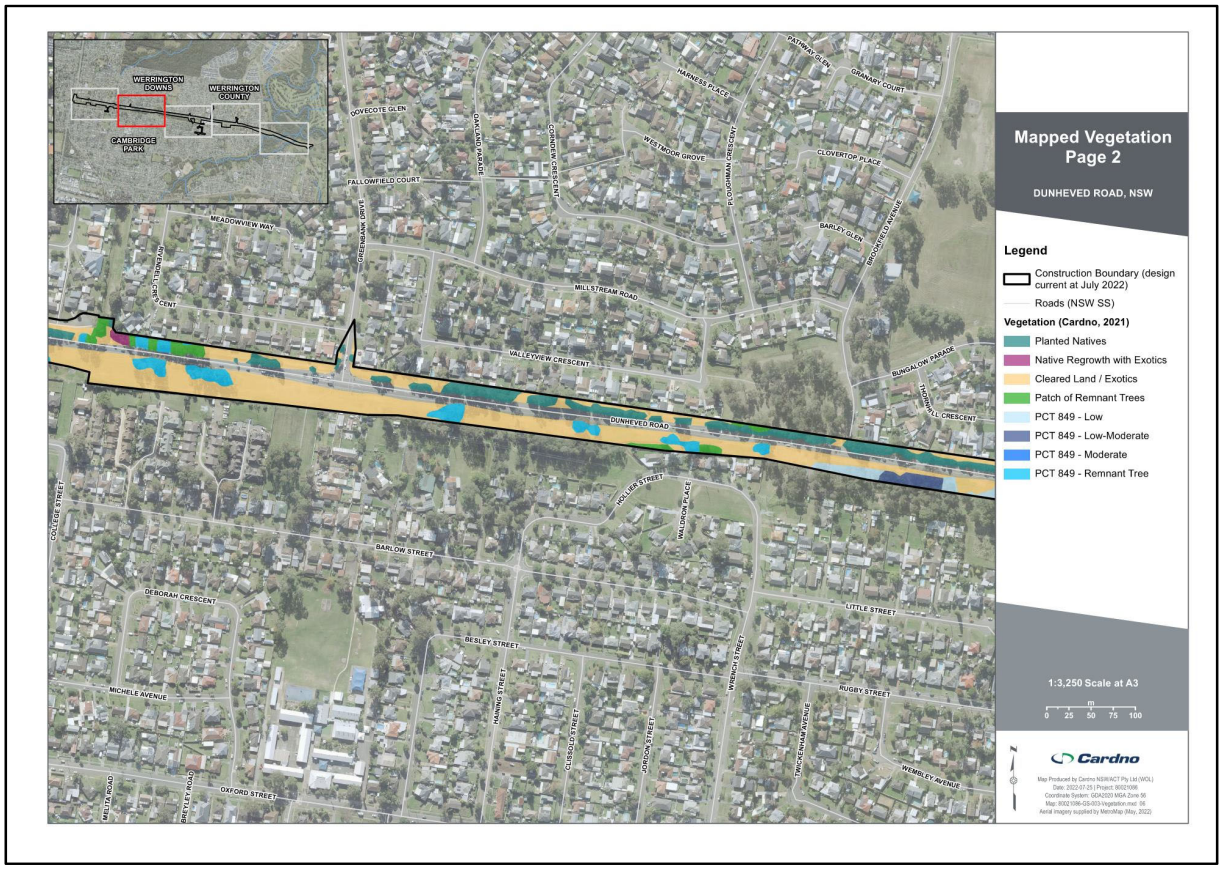

Figure 3-2 Study Area section 2 – Ground-truthed Vegetation

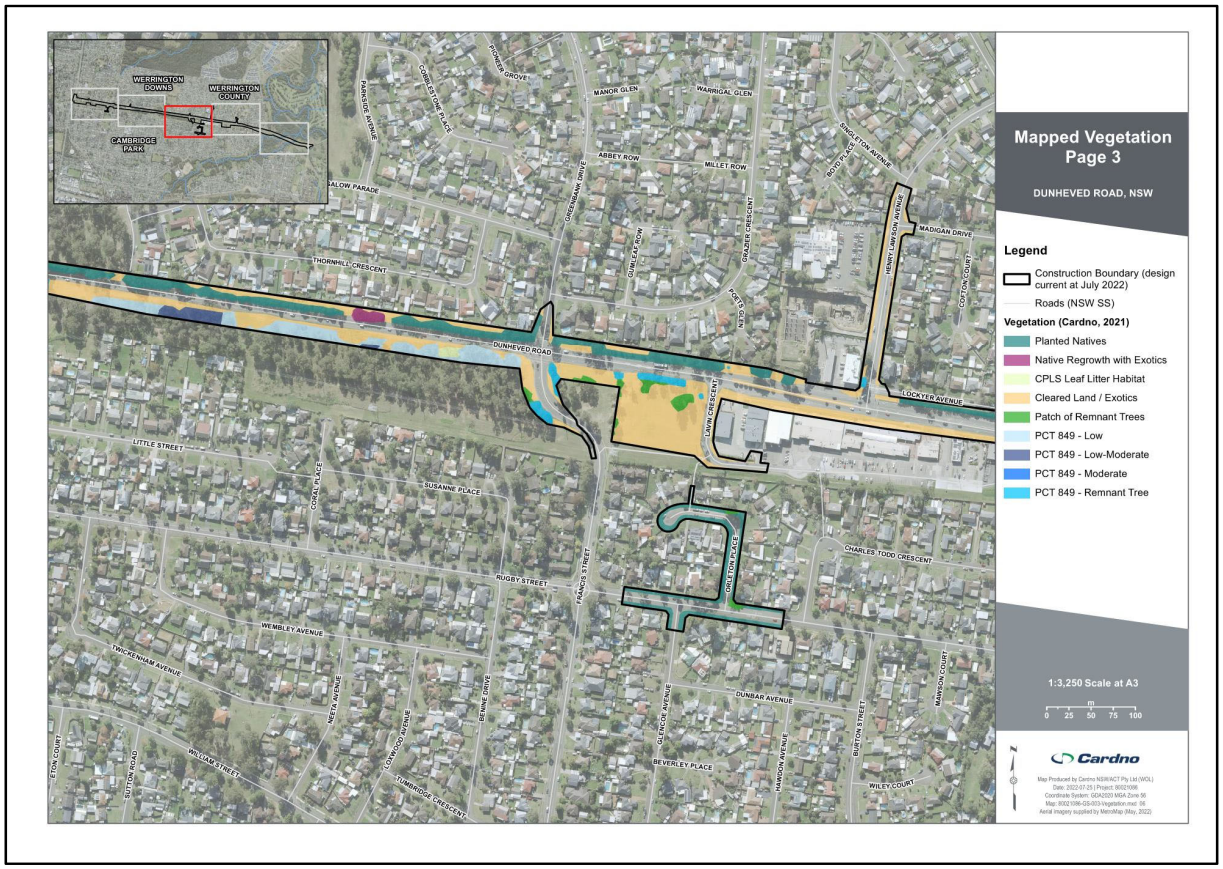

Figure 3-3 Study Area section 3 – Ground-truthed Vegetation

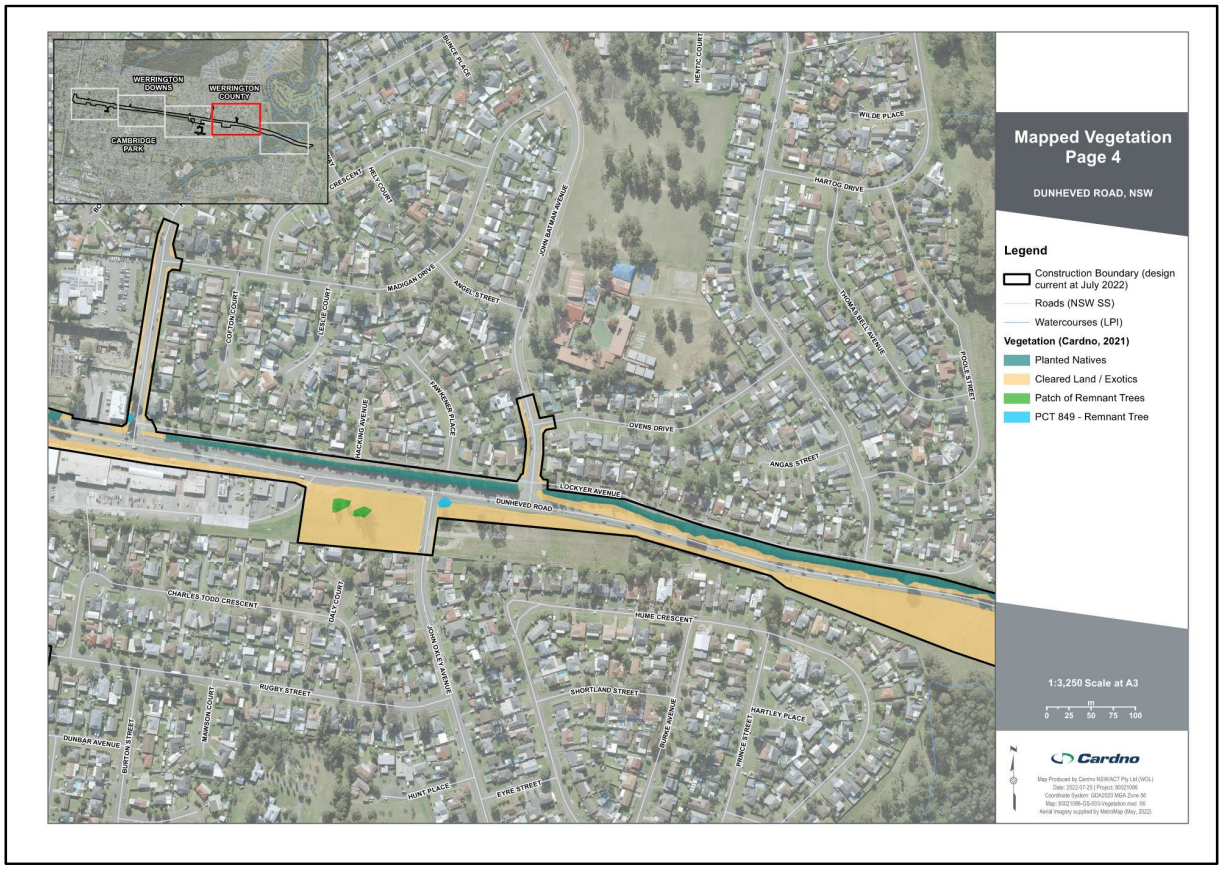

Figure 3-4 Study Area section 4 – Ground—truthed Vegetation

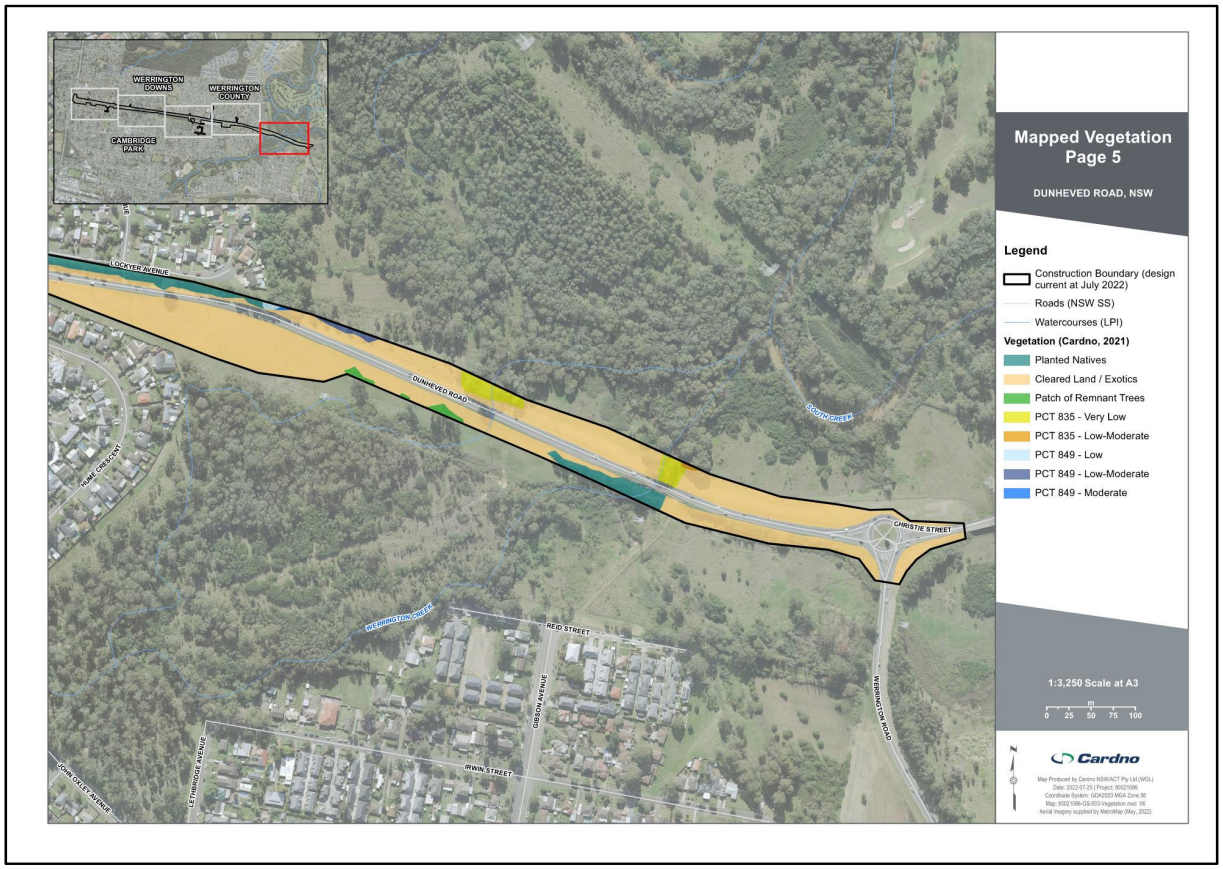

Figure 3-5 Study Area section 5 – Ground-truthed Vegetation

3.1.2 Fauna Species

Table 3-2 provides list of fauna species recorded within the Study Area. One threatened fauna species was recorded, Cumberland Plain Land Snail (*Meridolum cornovirens*), a shell and the fragment of a shell were found during targeted surveys in February 2022.

Table 3-2 List of Fauna Species

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status
Birds				
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	P	-
Artamidae	*Cracticus tibicen*	Australian Magpie	P	-
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P	-
Charadriidae	*Vanellus miles*	Masked Lapwing	P	-
Corcoracidae	*Struthidea cinerea*	Apostlebird	P	-
Corvidae	*Corvus coronoides*	Australian Raven	P	-
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P	-
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P	-
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P	-
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P	-
Meliphagidae	*Anthochaera* sp.	Unidentified Wattlebird	P	-
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P	-
Meliphagidae	*Manorina melanophrys*	Bell Miner	P	-
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P	-
Mammals				
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P	-
Gastropods				
Camaenidae	*Meridolum corneovirens*	Cumberland Plain Land Snail	E	-

Key:

BC Act = NSW Biodiversity Conservation Act 2016; EPBC Act = Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

Status: P = protected; E = Endangered;

3.1.3 Terrestrial fauna habitats

Table 3-3 provides a summary of fauna habitat observed within the Study Area.

Table 3-3 Fauna Habitat Values

Habitat Value	Description
Native vegetation and canopy	Native vegetation (remnant, planted, patches of trees and paddock trees) provides suitable habitat for fauna species. This includes, roosting and nesting habitat, foraging resources (e.g. seasonal nectar, flowers and fruit and foraging ground for insects/small reptiles).
Hollow-bearing Trees	Few small hollows (i.e. <20 cm diameter) were observed in trees, and most observed were at the base of trees. This provides potential habitat for small fauna species, including birds, reptiles and small mammals. No tree hollows were observed at height on trunks of trees within the Study Area.
Stags	Several stags were observed across the Study Area. Stags provide suitable habitat for birds, small reptiles and microbats.
Logs	None observed.
Rocky Outcrops	None observed.

Habitat Value	Description
Caves	None observed. A small culvert was observed within the Study Area, no evidence of microbat occupancy was noted. A road bridge is present over Werrington Creek, the bridge provides potential habitat for birds (e.g. good swallows) and microbats.
Leaf Litter	Leaf litter was observed at the base of some trees and in vegetated areas (e.g. in PCT 849). Leaf litter provides habitat for small fauna species, including small reptiles, small mammals and invertebrates (e.g. snails). A search for the Cumberland Plain Land Snail (CPLS) was undertaken at a tree with a large amount of leaf litter on 23 September 2021. The day was dry and no rain occurred during the nine days prior to the site inspection. Although not the best suitable conditions for surveys were meet at the time of site inspection, it is known that where the CPLS occur, presence of shells can persist. Hence a search for shells was undertaken but no shells or individuals were recorded. Targeted surveys for CPLS were undertaken on 23 February 2022, after rain and in suitable leaf litter habitat. A shell and a fragment of the shell of a CPLS were found.
Decorticating bark	Decorticating bark was observed in some trees. This provides suitable habitat for small species, e.g. lizards, insects and microbats.
Burrows, nests and other fauna made habitat	One empty nest was observed in a shrub located in Werrington Creek riparian corridor. The nest was empty and was probably a small passerine bird's nest.
Connectivity	The Study Area is located within a predominantly residential/commercial landscape. The only area with some degree of connectivity is Werrington Creek's riparian corridor. The high level of weed cover in the riparian corridor would provide roosting habitat for highly mobile fauna (e.g. birds) and would favour their movements along Werrington Creek and South Creek riparian corridors. However, the presence of the road bridge and fences would prevent movement of ground-dwelling fauna.
Aquatic Habitat	One creek occurs within the Study Area, Werrington Creek (a third order stream) which is crossed by Dunheved Road via a road bridge. The creek is highly degraded with eroded banks lacking riparian vegetation. Aquatic vegetation, both submerged aquatic vegetation (SAV) and emergent aquatic vegetation (EAV), is absent in the creek channel. The lack of aquatic vegetation in the creek channel and banks results in the creek having substandard value as habitat for aquatic and terrestrial fauna. The creek has limited potential to provide substandard foraging habitat for terrestrial species (e.g. fishing bat (*Myotis macrus*) and frogs). Some terrestrial animals could drink water from the creek (e.g. water dragons, birds and ground-dwelling fauna).

3.1.4 Threatened ecological communities

The desktop review revealed seven TECs listed under the BC Act and/or EPBC Act with potential to occur within the Study Area. These PCTs are:

- Castlereagh Scribbly Gum and Agnes Banks Woodland of the Sydney Basin Bioregion, listed as Critically Endangered Ecological Community (CEEC) under the BC Act and as an Endangered Ecological Community (EEC) under the EPBC Act.
- Coastal Swamp Oak (*Cassuarina glauca*) forest of New South Wales and South East Queensland ecological community, listed as an EEC under the BC Act and the EPBC Act;
- Cooks River/ Castlereagh Ironbark Forest of the Sydney Basin Bioregion, listed as an EEC under the BC Act and as a CEEC under the EPBC Act;
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, listed as an CEEC under the BC Act and EPBC Act;
- River-flat Eucalypt Forest on coastal floodplains of southern New South Wales and eastern Victoria, listed as an EEC under the BC Act and as a CEEC under the EPBC Act;
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion, listed as a CEEC under the BC Act and the EPBC Act;

> Western Sydney Dry Rainforest and Moist Woodland on Shale, listed as an EEC under the BC Act and as a CEEC under the EPBC Act.

As shown in **Table 3-4**, two of the PCTs recorded within the Study Area are associated with TECs and these were confirmed to occur within the Study Area.

Table 3-4 Threatened Ecological Communities

PCT ID	PCT Name	Act	TEC Name	TEC Status	Is PCT commensurate with TEC?
849	Cumberland Shale Plains Woodland	BC Act	Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	Yes, patches of the vegetation with canopy, shrub and ground cover meets the typical community structure as an "*open canopy, a near continuous groundcover dominated by grasses and herbs, sometimes with layers for shrubs and/or small trees*" and the composition of species being characteristic of the TEC (NSW TSSC 2010).
					The final determination is unclear as to whether or not paddock trees and patches of remnant trees with exotic groundcover, and where no other native strata is present, would constitute part of the TEC. Clarification has been sought from the NSW Threatened Species Scientific Committee. At the time the BAR was prepared, a response from the NSW TSSC indicated that remnant and paddock trees are considered part of the TEC (see Appendix B).
		EPBC Act	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CEEC	Yes, the vegetation is commensurate with the EPBC Act listed TEC (DEWHA 2009, TSSC 2009). Overall, the patches of PCT 849 meet the patch size and native cover criteria for Category A patches of the TEC.
					Remnant trees and paddock trees do not confirm to the EPBC Act listed TEC.
835	Cumberland Riverflat Forest	BC Act	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	Yes, patches of PCT 835 within the Study Area are considered commensurate with the BC Act listed TEC due to the vegetation structure, location in floodplain and to the native component being consistent with characteristic species of the TEC.
		EPBC Act	River-flat Eucalypt Forest on coastal floodplains of southern New South Wales and eastern Victoria	CEEC	Partially, only patches of PCT 835 low-moderate condition are commensurate with the EPBC Act listed TEC due to the dominance of canopy species (DAWE 2020).

Act: BC Act = NSW Biodiversity Conservation Act 2016; EPBC Act = Commonwealth Environment Protection and Biodiversity Conservation Act 1999

TEC Status: EEC = Endangered Ecological Community; CEEC = Critically Endangered Ecological Community

3.1.5 Threatened, migratory and protected species

A total of 43 threatened species and 15 migratory species were predicted to occur within the Study Area based on BioNet Atlas and PMST report. A likelihood of occurrence assessment was undertaken to assess the likelihood of the predicted threatened biodiversity occurring in the Study Area. The likelihood of occurrence of each species is assessed as per criteria provided in **Table A-1** (**Appendix A**) and a category

of likelihood is provided based on availability of habitat in the Study Area. The likelihood of occurrence table with assessment for all predicted species is provided in **Table A-2** (**Appendix A**).

Although foraging habitat in the Study Area occurs for these threatened, migratory and protected fauna, the habitats are considered suboptimal due to the level of disturbance, their fragmented condition and their location on a highly developed urban landscape with limited connectivity. For mobile species, such as birds and microbats, more suitable habitat is likely available in larger remnant patches of woodland in the broader locality. Therefore, it is unlikely that any of these species that occasionally occurred in the Study Area would depend on habitats in the Study Area and the resources they may provide.

Notwithstanding this, eleven species were considered to have moderate likelihood of occurrence in the Study Area (See **Table A-2** in **Appendix A**), including one species of flora, three microbat, six birds and one land snail.

The Juniper-leaved Grevillea (*Grevillea juniperina subsp. juniperina*) was not recorded during surveys in the Study Area.

None of the threatened fauna were seen during site inspections but one shell of the Cumberland Plain Land Snail (CPLS) (*Meridolum corneovirens*) which had been searched for in leaf litter at the base of paddock trees and during site inspections, was found. The presence of CPLS shells suggest that the species is and/or was present in the location within the last two years. The species has very cryptic lifestyle and local populations have small habitat range (up to 300m). Suitable habitat for the species includes native vegetation such as PCTs 949 and 835 present in the Study Area.

3.2 Aquatic environment

Two aquatic habitats were recorded in the Study Area section 5 (see **Figure 3-5**), as follows:

- Werrington Creek, a third order stream, and tributary of South Creek, which flows under a bridge over Dunheved Rd. The creek is highly disturbed with eroded banks, and no aquatic vegetation (emergent and submerged) present. The stretch of Werrington Creek within the Study Area is mapped as key fish habitat (NSW DPI, 2019e), but is considered to be Type 3 – Minimally sensitive key fish habitat (DPI 2013) due to the absence of native aquatic plants, unstable and eroded banks. The classification of Werrington Creek in relation to classification of waterways for fish passage (DPI 2013) corresponds to Class 3 – Minimal key fish habitat as it is an intermittent stream with a clearly defined bed and bank without freshwater aquatic vegetation present.
- A small drain line connected to a culvert which flows under Dunheved Rd and eventually into South Creek. The drain line was primarily composed of exotic weeds, shallow and have no suitable habitat for protected or threatened aquatic species and would only flow after rain.

3.2.1 Threatened ecological communities

The desktop review did not identify any listed aquatic threatened ecological community (TEC) with potential to occur within the Study Area.

No aquatic TEC was observed in the Study Area during the site inspection. Hence, aquatic TECs would not be considered any further in this assessment.

3.2.2 Threatened, migratory and protected species

The desktop review revealed four threatened species/endangered populations and eight migratory wetland species listed under the FM Act and/or EPBC Act with potential to occur within the Study Area. The predicted threatened species included three vulnerable species (one fish species and two amphibians), one endangered fish species and eight migratory bird species.

An assessment on the likelihood of occurrence of the predicted threatened species was undertaken (see **Appendix A**). Based on the assessment, it was concluded that all predicted threatened species had low likelihood of occurrence within the Study Area. These species will no longer be considered in further assessment.

3.2.3 Aquatic pests and diseases

Werrington Creek, which crosses the Study Area, is part of the Hawkesbury River system. The following freshwater pest species and diseases are known to occur in the Hawkesbury:

- Redfin Perch (*Perca fluviatilis*);

- Pacific oyster (*Crassostrea gigas*);
- Carp (*Cyprinus carpio*);
- Eastern gambusia (*Gambusia holbrooki*);
- Goldfish (*Carassius auratus*);
- Oriental weatherloach (*Misgurnus anguillicaudatus*);
- Caulerpa (*Caulerpa taxifolia*)
- Pacific oyster mortality syndrome (POMS);
- Queensland unknown (QX);
- Epizootic ulcerative syndrome (EUS) also known as red spot disease.

No aquatic vegetation, including exotic species, were recorded in the stretch of Werrington Creek within the Study Area.

4 Assessment of impacts

4.1 Construction phase

4.1.1 Terrestrial biodiversity

4.1.1.1 Direct Impacts

4.1.1.1.1 Direct Impacts: Native Vegetation

Loss of habitat will result due to clearing of native vegetation, removal of trees and clearing of planted native vegetation (see **Table 4-1**). Up to 5.15 ha of native vegetation will be cleared within the Construction Boundary, including:

- 0.22 ha of PCT 835;
- 1.34 ha of PCT 849
- 0.05ha of native regrowth with exotics;
- 0.47ha of remnant and paddock trees;
- 3.07ha of planted natives.

As indicated in **Section 2.2.3**, five of the vegetation zones correspond to BC Act listed TECs and four vegetation zones correspond to EPBC Act listed TECs. Up to 1.34 ha (see **Section 3.1.1**) of Cumberland Plain Woodland (CPW) and up to 0.22 ha of River-flat Eucalypt Forest TECs will require removal, although only 0.62 ha of the total CPW to be removed meets the criteria for the EPBC Act listed TEC. To address this, is noted that Penrith City Council, the Dunheved Road Proponent, has opted into the BOS and preparation of a Biodiversity Development Assessment Report has commenced (see **Section 4.3**).

Proposed mitigation measures (refer **Section 5)** include managing edge effects and offsetting according to the biodiversity offsets scheme (BOS) part of the BC Act. If the offsetting is to include like-for-like replanting (i.e. if there was adequate space to do this), then there would likely be no net loss to BC Act or EPBC Act listed CPW TECs. Given it is not yet known if this type of offsetting is feasible the BC Act Test of Significance and EPBC Act Assessment of Significance for these TECs (see **Appendix C**) precautionarily concluded that, although remaining patches of the TECs in and adjacent to the Study Area would be viable, the removal of patches of the TECs would potentially contribute to cumulative impacts (i.e. in conjunction with historical clearing from other projects) to CPW at a broader level. Given cumulative impacts erode the long-term viability of the TECs within the broader locality, even small clearances of CPW TECs that cant be mitigated to the level of 'no net loss' could be considered a significant impact. As such, it may be precautionary to prepare a Referral to the Commonwealth in regards to potential impacts of the project to CPW TECs.

Given only a small amount of 0.22 ha of BC Act listed River-flat Eucalypt Forest is proposed to be removed (and that most of this, 0.21 ha in is the very-low condition), and that larger patches in better condition remain in the locality, the clearance required for the project would not affect the viability of River-flat Eucalypt Forest within and adjoining the Study Area. Only 0.01 ha of low-moderate condition River-flat Eucalypt Forest to be

cleared meets the EPBC Act listing threshold. Given the clearance of this very small amount is likely able to be offset by like-for-like replanting (i.e. so there would be no net loss) it would not be considered a significant impact.

Table 4-1 Direct impact due to clearing

Vegetation Zone	TEC Associated	TEC Status BC Act | EPBC Act	Clearing extent (ha)
PCT 835_Low-moderate	RFEF	EEC | CEEC	0.01
PCT 835_Very Low			0.21
PCT 849_Moderate	CPW	CEEC | CEEC	0.01
PCT 849_Low-moderate			0.14
PCT 849_Low			0.47
PCT 849_Remnant trees		CEEC | NA	0.72
Patch of remnant trees	-	-	0.47
Planted natives	-	-	3.07
Native regrowth with exotics	-	-	0.05
Total clearing (ha)			**5.15**

TECs (name BC Act | name EPBC Act): RFEF = River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria; CPW = Cumberland Plain Woodland | Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest

Status: EEC = Endangered Ecological Community; CEEC = Critically Endangered Ecological Community

NA – Not applicable as the vegetation zone is not commensurate with the TEC.

4.1.1.1.2 Direct Impacts: Cumberland Plain Land Snail

PCT 849 and PCT 835 are known habitat for the Cumberland Plain Land Snail (CPLS) and hence the loss of the extent of these PCTs also represents a direct loss of habitat for the CPLS. An assessment of significance was undertaken for the CPLS (see **Table C-3** in **Appendix C**) and it was concluded that provided adequate protocol for pre-clearing and clearing is prepared and implemented prior to commencement of construction phase of the project, it is unlikely that significant impacts on a local population of the CPLS would occur. As indicated above, given CPLS's habitat would not be significantly affected by the project (i.e. these PCTs would remain viable within and adjoining the Study Area), it is not expected that there would be impacts to the CPLS. Further, a Plan of Management proposed for the CPLS will ensure long-term viability of snails in translocated areas.

4.1.1.1.3 Uncertain Direct Impacts: Southern Myotis

The Study Area provides foraging habitat for insectivorous microbat species. Also, roosting habitat for the Southern Myotis within the Study Area includes the underbridge at Werrington Creek, a tributary of South Creek. Foraging habitat for Southern Myotis, which forages over streams and pools catching insects and small fish across the water surface, occurs at South Creek and Werrington Creek. It is considered that foraging habitat under and adjacent to the bridge is limited and seasonal as observations therein suggest that water levels are variable, with inundated channel present only after heavy rain events. The scope of works for the present assessment was limited to fauna habitat assessment within the Study Area and opportunistic observations for flora and fauna. An assessment of significance was undertaken for three microbat species, the Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Southern Myotis (*Myotis macropus*) (see **Table B-1** in **Appendix B**) and it was concluded that based on the information available to date, it is considered unlikely the proposed road upgrade would result in adverse effect on the life cycle of the Eastern Coastal Free-tailed Bat and the Greater Broad-nosed Bat, nor would a local population of these species be placed at risk of extinction. It was also concluded, that in the case of the Southern Myotis, it is uncertain if this fishing bat roosts and/or breeds under the road bridge, therefore, the possibility that the proposed road upgrade would have an adverse effect on the life cycle of Southern Myotis cannot be precluded. Additional assessment of the underbridge as habitat for Southern Myotis and assessment of the use of the underbridge as a roosting and/or breeding habitat warrants further survey and will be undertaken as part of BDAR assessment (see **Section 4.3**).

4.1.1.2 Indirect impacts

The following indirect impacts are likely to arise from the works related to the project:

- Weed invasion due to creation of edges in patches of native vegetation and due to cross-contamination of vegetated areas with tissue of exotic species transported in machinery, tools, PPE or imported soils (if required).
- Infection of aquatic fauna (e.g. frogs) and native species (e.g. plants of the family Myrtaceae) due to introduction of pathogens in soils on machinery, tools or PPE.
- Change of hydrological patterns due to surface run-off.
- Accidental death of protected fauna during vegetation clearing and removal of trees.
- Temporary disturbances to native fauna occupying the road bridge (e.g. potential roost habitat for Southern Myotis).

4.1.2 Aquatic biodiversity

4.1.2.1 Direct impacts

The proposed project would require widening of the overbridge at Werrington Creek. It is understood that the bridge extension will be located outside the creek channel and that footings would be outside the riparian corridor.

Some construction activities have the potential to directly impact the creek, for example by contaminating the creek with building materials (e.g. concrete sludge) and/or accidentally dropping construction materials into the creek channel and care will be required to avoid these impacts (see **Section 5**).

With mitigation in place as per Section 5 and given the extensions to the bridge will not require structures within the creek bed or riparian corridor, there would be no direct impacts on the creek or its aquatic habitat (e.g. aquatic vegetation, boulders).

4.1.2.2 Indirect impacts

Impacts on water quality of Werrington Creek have the potential of indirectly impacting aquatic fauna.

It is noted that no native aquatic vegetation will be impacted at the site as none is present in the creek and that given the highly disturbed condition of the creek, it is not considered to be suitable habitat for freshwater threatened species at the site or in nearby downstream areas. However, the possibility of the creek being inhabited or occasionally (seasonally or during movements up/down stream) being used by native protected aquatic fauna (e.g. turtles, eels and macroinvertebrates) cannot be precluded.

Migration of sediment into the creek from the works area could result in indirect impacts on aquatic native fauna by indirectly impacting the water quality of the creek or the depth of the creek. Reduction in water quality of creeks could results in reduction of biodiversity of invertebrates, which in turn could affect feeding resources for other organisms at upper levels in the food chain (e.g. frogs, birds, reptiles, microbats) at the site and in downstream habitats. Notwithstanding this, these potential impacts will be avoided if standard controls for protecting the creek, and drainage lines, from runoff from the works are implemented (see **Section 5**).

4.2 Operation phase

No impacts to terrestrial or aquatic biodiversity are expected to occur as result of the proposed road upgrade and during the operational phase.

4.3 BC Act and the Biodiversity Offsets Triggers

The NSW *Biodiversity Conservation Act 2016* (BC Act) is the current legislative instrument that sets the rules for assessment of impacts of development on biodiversity (e.g. flora and fauna) in NSW. In general, a Biodiversity Development Assessment Report (BDAR) is now required for all development applications within NSW which require clearing of native vegetation. A BDAR will be required to accompany a development application when native vegetation is proposed to be cleared and the Biodiversity Offsets Scheme (BOS) is triggered. The BDAR details the impacts that the development may have on threatened biodiversity and provides recommendations to help ameliorate the impacts. It also outlines the development restrictions within a site, based on the site's ecological values, and provides options and conditions on which the development can proceed.

Based on impact assessment undertaken as part of this BAR, it is considered that the proposed project is likely to result in significant impacts on threatened biodiversity (i.e. TECs, threatened species or their habitat). Additional surveys as per the Biodiversity Assessment Method (BAM) and avoidance of net-loss are proposed to further assess identified impacts and avoid net-loss of biodiversity via offsetting residual impacts as per the BOS.

Table 4-2 provides the BOS triggers and their applicability to the proposed project.

The following is understood about the proposed road upgrade project and with regards to applicability of the BOS:

- It is understood that the proposed Dunheved Road Upgrade project is a Part 5 Development as per the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and will be assessed under the State Environmental Planning Policy (infrastructure) 2007 (Infrastructure SEPP). Division 4 of the ISEPP states that exempt development may be carried out without the need for development consent under Part 5 of the EP&A Act where it is stated that exempt development:
  - (*a) must be of minimal environmental impact; and*
  - *(b) cannot be carried out in critical habitat of an endangered species, population or ecological community (identified under the Threatened Species Conservation Act 1995* [replaced by the BC Act] *or the Fisheries Management Act 1994), and*
  - *(c) cannot be carried out in a wilderness area (identified under the Wilderness Act 1987)*.
- Division 17, Clause 94 (1) of the Infrastructure SEPP states that development permitted without consent – general is “Development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land [part]”.
- Based on the NSW Biodiversity Offsets Scheme and Land Management Framework Biodiversity Assessment and Approval Pathways for local government, the proposed Dunheved Road Upgrade project requires Council approval. Due to the identified likelihood of significant impacts on threatened biodiversity arising by the proposed project, Penrith City Council, as the consent authority, has the following options:
  - Prepare a Species Impact Statement (SIS); or
  - Opt into the BOS which requires preparation of a BDAR by an accredited assessor.

Penrith City Council has opted into the BOS and preparation of a BDAR is underway. The BDAR is being prepared as per the following phases:

- Phase 1: Desktop review and initial surveys. Initial surveys were undertaken in May 2020 and included detailed BAM plots and bird surveys. BAM plot data was included in the BAM calculator (BAM-C) to identify candidate ecosystem credit species (ECS) and species credit species (SCS). Survey plan preparation is underway and will inform additional targeted surveys for Phase 2.
- Phase 2: Targeted Surveys.
- Phase 3: Reporting.

Due to survey times for species credit species, it has been estimated that the BDAR will be ready at end January 2023.

The Department of Planning and Infrastructure (DPE) via their Environment and Heritage Group (EHG) has confirmed that DPE concurrence on the BDAR for the proposed project is not required. DPE’s EHG indicated that the consent authority (i.e. Penrith City Council) is responsibly to ensure adequacy of the BDAR for inclusion in the REF.

Table 4-2 Biodiversity Offset Scheme Triggers

BOS Triggers	Applicability to the Proposed Project	Is the BOS triggered?
The land where the proposed development will occur is mapped as having high biodiversity values in the Biodiversity Values Map (BVM)	Yes, as shown in **Figure 4-1** high biodiversity values are mapped in the BVM which occur within the Study Area. The high biodiversity value areas mapped include: ▪ Road reserve, part Lot 20 DP1075359 and part Lot 38 DP607665: planted natives and remnant native trees. ▪ Road reserve, part Lot 7 DP243000, part Lot 2 DP250937, Lot 15 DP242997: PCT 849 – Cumberland Shale Plains Woodland, commensurate with BC Act and EPBC Act listed CEEC Cumberland Plain Woodland. ▪ Road reserve, part Lot 62 DP611060: remnant native trees ▪ Road reserve: PCT 835 – Cumberland Riverflat Forest. PCT 835 is commensurate with BC Act listed EEC River-flat Eucalypt Forest. Only areas of PCT835 in low-moderate condition are commensurate with EPBC Act listed CEEC River-flat Eucalypt Forest.	Yes. Based on the existing Biodiversity Values Map and TEC recorded. It is noted, that not all the land mapped in the BVM as high biodiversity values correspond to a PCT or TEC based on the ground-truthed vegetation. The proponent can contact the NSW Department of Planning and Environment to: ▪ Apply for a Biodiversity Values Explanation Report; and/or ▪ Apply for a Biodiversity Values Map Review to have the mapped area modified to reflect current conditions.
The proposed development will require clearing of native vegetation at or above the “Area Clearing Threshold”. As shown in table below, the “Area Clearing Threshold” is associated with the minimum lot size associated with the property. **Table: BOS Area Clearing Threshold** **Minimum Lot Size Associated with the Property** / **Threshold for Clearing, above which the BAM and BOS apply** Less than 1 ha — 0.25 ha or more 1 ha to less than 40 ha — 0.5 ha or more 40 ha to less than 1000 ha — 1 ha or more 1000 ha or more — 2 ha or more *Area Clearing Threshold as per https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity-offsets-scheme/about-the-biodiversity-offsets-scheme/when-does-bos-apply*	The Biodiversity Values Map and Threshold Report (BMAT) Report (see **Appendix D**) indicates that the minimum lot size where native vegetation occurs range between 0.01 ha (141 m^2) and 0.45 ha (4,507 m^2). Based on the minimum lot size within the Study Area, am “Area Clearing Threshold” of 0.25 ha applies to the Study Area. The proposed project will require clearing of up to 5.15 ha of native vegetation, including: ▪ 1.34 ha of Cumberland Plain Woodland ▪ 0.22 ha of River-flat Eucalypt Forest ▪ 0.47 ha of remnant trees ▪ 3.07 ha of planted natives ▪ 0.05 ha of native regrowth with exotics 5.15 ha of native vegetation surpasses “Area Clearing Threshold. Therefore, the BOS is triggered based on the “Area Clearing Threshold”.	Yes
The proposed development would likely affect significantly threatened biodiversity or their habitat. Threatened biodiversity includes threatened ecological communities (TECs), threatened species, threatened populations and their habitat.	In accordance with the Likelihood of Occurrence and Risk assessment (**Section 4** and **Appendix A**) and the Assessment of Significance for the threatened biodiversity considered (see **Appendix C**), the proposed project is likely to result in significant impacts on threatened biodiversity, including:	One TEC and one threatened species were identified as likely to be significantly impacted by the proposal. Mitigation measures had been provided to minimise residual impacts which could not be avoided. Furthermore, the development

BOS Triggers	Applicability to the Proposed Project	Is the BOS triggered?
	▪ Cumberland Plain Woodland (see **Section C.1.4**) ▪ Cumberland Plain Land Snail (see **Section C.1.3**)	proponent has opted into the BOS and offsets as per the BOS will be undertaken to avoid net-loss.
The proposed development is carried out in a declared area of outstanding biodiversity value (AOBV).	Areas of Outstanding Biodiversity Value (AOBV) are declared by the NSW Minister for the Environment and under the BC Act. The register of AOBV indicates that at the time of assessment (25 July 2022), there are four declared AOBV: ▪ Gould's Petrel – Critical Habitat Declaration; ▪ Little Penguin population in Sydney's North Harbour – Critical Habitat Declaration; ▪ Mitchell's Rainforest Snail in Stotts Island Nature Reserve – Critical Habitat Declaration; and ▪ Wollemi Pine – Critical Habitat Declaration. The proposed project is not located near or at any of the AOBV. Therefore, it is considered that the proposed project is unlikely to result on any direct or indirect impacts on AOBV.	No

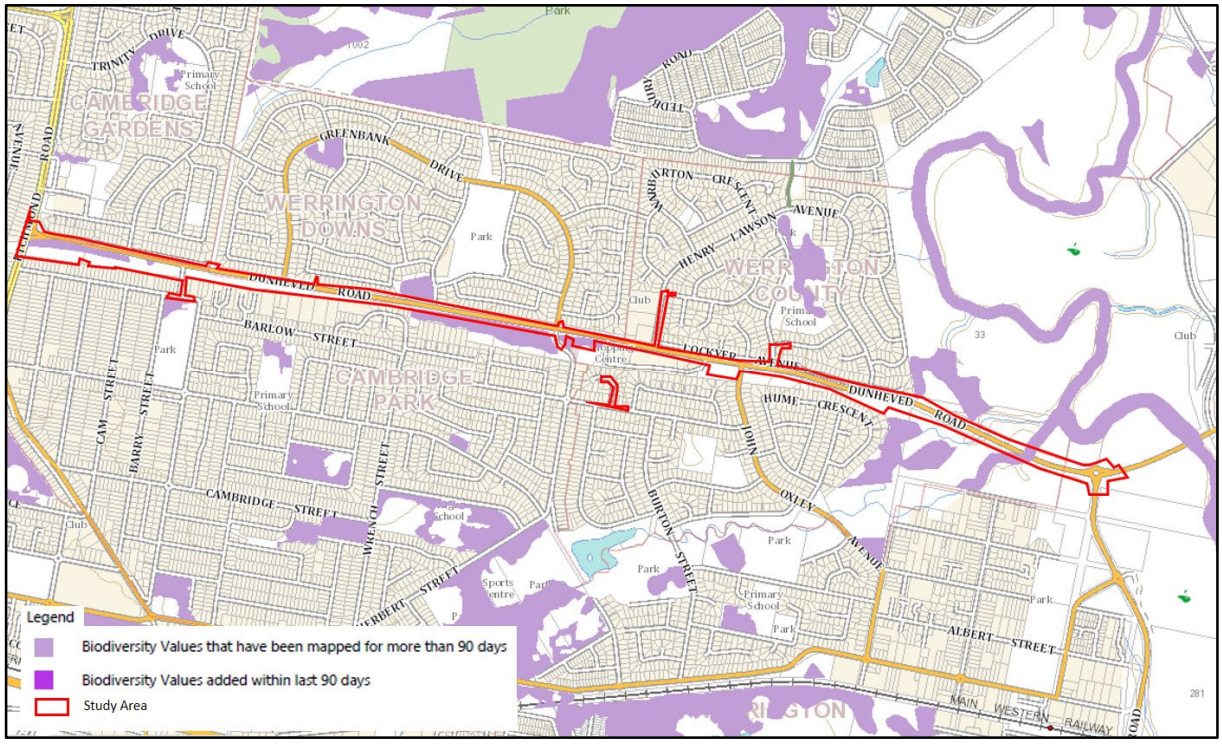

Figure 4-1 Study Area and Biodiversity Values Map (BVM accessed 13 July 2022)

5 Mitigation measures

Table 5-1 outlines measures that would be implemented to manage and mitigate potential impacts to biodiversity.

Table 5-1 Mitigation Measures

Potential impact	Mitigation measures
Habitat loss due to clearing of native vegetation, trees and/or planted native vegetation	Compensatory replanting of trees at a rate 1:1. Plantings to be placed on road reserve.
	Offsets to be met in accordance with the BOS for loss of 0.62 ha of Cumberland Plain Woodland and loss of 0.22 ha of River-flat Eucalypt Forest. Both PCTs are habitat for the Cumberland Plain Land Snail (CPLS). The CPLS was recorded in a patch of PCT 849.
	Avoid and minimise loss of CPLS by: ▪ Preparing and implementing a pre-clearance and clearance protocol prior to commencement of construction phase. This protocol will avoid and minimise (as far as practicable) loss of individuals of the CPLS from the Study Area. The protocol must include methodology to search for and identify individuals of the species, and have identified a suitable location within the Study Area to translocate individuals to (e.g. part of patch of PCT849 to be retained) or a known site inhabited by the species. ▪ Preparation and implementation of a CPLS Plan of Management to prevent degradation or loss of the

Potential impact	Mitigation measures
	translocation location/site. This will support viability of the site for the long-term survival of the CPLS population receiving the translocated individuals.
Weed invasion or dispersion	Strict weed management, monitoring and control practices should be implemented as part of the Construction Environmental Management Plan (CEMP) to minimise the spread of exotic species into natural areas within and outside of the Study Area. In particular, priority weed and high threat exotic species should be targeted in accordance with the NSW DPI WeedWise recommended control measures (DPI 2022).
Introduction of diseased to flora and fauna	Riparian corridors beyond footprint extent to be fenced off and labelled as No-Go areas to prevent accidental impacts and introduction of pathogens, such as *Batrachonchtrium dendrobatidis*, a pathogen that caused chytridiomycosis, an infection disease on amphibians.
	All machinery should be cleaned of foreign soil and vegetative matter to avoid the spread of *Phytophthora cinnamomi*, Exotic Rust Fungi of the order Pucciniales pathogenic (Myrtle Rust) and dispersal of seeds of non-native plants
Incidental death of protected fauna during vegetation clearing and tree removal	Wildlife protection during construction by implementing the following: ▪ Stop-work procedure on the chance encounter of any dispersing wildlife during works should be implemented to avoid death or injury; ▪ Ensure that a suitable qualified ecologist is present during the removal of all trees to act as a spotter / catcher that can relocate any captured wildlife; ▪ Ensure that all captured animals are relocated into the nearest suitable native vegetation; and ▪ Ensure that all injured animals are taken to a local wildlife carer for treatment
Contamination of, or mobilisation of sediment or turbid runoff into, Werrington Creek due to changes in hydrological patterns of surface run-off	Strict erosion and sediment control measures should be implemented as part of the CEMP, monitored and maintained to prevent impacts on areas adjacent to the works areas, particularly drainage lines and Werrington Creek, and following erosion and sediment mobilisation from rain events.
	Stockpiling of materials should occur within previously disturbed areas and not within driplines, retained vegetation or within 20 m of Werrington Creek.

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APPENDIX

A

LIKELIHOOD OF OCCURRENCE

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A.1 Likelihood of Occurrence Assessment

Threatened species, populations and ecological communities, and migratory species (listed under the BC Act, FM Act and/or EPBC Act) that are known, or have potential, to occur within a 5 km radius of the Study Area have been considered in this section. The likelihood of occurrence within the Study Area of each species or TEC was assessed using the criteria described in **Table A-1** and the findings presented in **Table A-2**. This assessment was undertaken based on previous records, the results of the field survey and known species habitat requirements. **Table A-2** also provides an assessment of the potential impact of the proposed project on each species and TEC.

Table A-1 Likelihood of Occurrence Criteria

Likelihood Rating	Criteria
Known	The species was recorded within the Study Area during the field surveys.
High	It is likely that a species would inhabit or utilise habitat within the Study Area. Criteria for this category may include: > Species recently and/or regularly recorded in contiguous or nearby habitat; > High quality habitat or resources present within the Study Area; > Species is known or likely to maintain a resident population surrounding the Study Area; and > Species is known or likely to visit during migration or in response to seasonal availability of resources present on site.
Moderate	Potential habitat for a species occurs within the Study Area. Criteria for this category may include: > Species previously recorded in contiguous habitat albeit not recently (>10 years); > Habitat present, but poor quality, depauperate or modified types and/or resources; > Species has potential to utilise habitat during migration or seasonal availability of resources; and > Cryptic flora species with potential habitat within the Study Area that have not been targeted by surveys (for example, surveys were not undertaken with the flowering season.
Low	It is unlikely that the species inhabits the area, if it did, it would likely be a transient visitor. Criteria for this category may include: > The Study Area does not support the specific habitat types or resources required by the species; > The Study Area is beyond the current distribution of the species or is isolated from known populations; and > Non-cryptic flora species not observed during targeted surveys.
None/Absent	The habitat within the Study Area is unsuitable for the species.

Table A-2 Likelihood of Occurrence and Risk Assessment for Threatened Species and Populations

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Fish					
Macquarie Perch (*Macquaria australasica*)	E	E	PMST-M	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water). Populations may survive in impoundments if able to access suitable spawning sites.	**None**. No suitable aquatic habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Australian Grayling (*Prototroctes maraena*)	E	V	PMST-L	The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones (such as the Tambo River, which is also known to have granite outcrops. The species has also been associated with clear, gravel-bottomed habitats in the Mitchell and Wonnangatta Rivers (Victoria) and in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea.	**None**. No suitable aquatic habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Gastropoda					
Cumberland Plain Land Snail (*Meridolum corneovirens*)	E	-	BioNet-109	Primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	**Moderate**. Suitable habitat occurs within the Study Area. Therefore, this species is considered likely of occurring. The shell and a fragment of a shell of the species was recorded in a patch of PCT 849 within the Study Area on 23 February 2022.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Dural Land Snail (*Pommerhelix duralensis*)	E	E	BioNet - 1	The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.	**Low**. Limited suitable habitat occurs within the Study Area, however, the patches of habitat within the Study Area are not part of the main distribution area for the species. Therefore, this species is considered to have low likelihood of occurring.
Frogs					
Giant Burrowing Frog (*Heleioporus australiacus*)	V	V	PMST-L	The northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites.	**Low**. Limited suitable habitat occurs within the Study Area. However, the Werrington Creek is highly degraded. Therefore, this species is considered to have low likelihood of occurring.
Green and Golden Bell Frog (*Litoria aurea*)	E	V	BioNet-3 PMST-K	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.	**Low**. Limited suitable habitat occurs within the Study Area. However, the Werrington Creek is highly degraded. Therefore, this species is considered to have low likelihood of occurring.
Birds					
White-throated Needletail (*Hirundapus caudacutus*)	-	V, C,J,K	PMST-K	Non-breeding habitat only: Found across a range of habitats, more often over wooded areas, where it is almost exclusively aerial. Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites.	**Low**. The species is migratory and highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Black-necked Stork (*Ephippiorhynchus asiaticus*)	E	-	BioNet-1	In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Australasian Bittern (*Botaurus poiciloptilus*)	E	E	PMST-K	In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly Bullrushes (*Typha* spp.) and Spikerushes (*Eleocharis* spp.).	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Black Bittern (*Ixobrychus flavicollis*)	V	-	BioNet-2	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.	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	V	-	BioNet-1	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	**None**. The species is migratory and occupy woodland near the coast, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Little Eagle (*Hieraaetus morphnoides*)	V	-	BioNet-2	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. She-oak or Acacia woodlands and riparian woodlands of interior NSW are also used.	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Square-tailed Kite (*Lophoictinia isura*)	V	-	BioNet-2	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.	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Australian Painted Snipe (*Rostratula australis*)	E	E	PMST-K	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Curlew Sandpiper (*Calidris ferruginea*)	E	CE, C,J,K	PMST-L	This species has a widespread distribution in NSW east of the Great Divide, particularly in coastal regions. The Curlew Sandpiper inhabits intertidal mudflats in estuaries and bays, lakes and lagoons.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Grey Falcon (*Falco hypoleucos*)	E	-	PMST-L	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Eastern Curlew (*Numenius madagascariensis*)	-	CE, C,J,K	PMST-M	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms. The numbers of Eastern Curlew recorded during one study were correlated with wetland areas.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	-	BioNet-2	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of she-oak occur. Black She-oak (*Allocasuarina littoralis*) and Forest She-oak (*A. torulosa*) are important foods.	**Low**. The species is highly mobile with limited suitable habitat occurs within the Study Area. Secondary foraging resources for the species occur in the Study Area Therefore, this species is considered to have low likelihood of occurring.
Little Lorikeet (*Glossopsitta pusilla*)	V	-	BioNet-4	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	**Moderate**. Suitable foraging habitat for the species occurs within the Study Area. Therefore, this species is considered to have moderate likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Swift Parrot (*Lathamus discolor*)	E	CE	BioNet – 14 PMST-K	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Inland Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*.	**Moderate**. Suitable foraging habitat for the species occurs within the Study Area. Therefore, this species is considered to have moderate likelihood of occurring.
Diamond Firetail (*Stagonopleura guttata*)	V	-	BioNet-1	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.	**Moderate**. Suitable foraging habitat for the species occurs within the Study Area. Therefore, this species is considered to have moderate likelihood of occurring.
Powerful Owl (*Ninox strenua*)	V	-	BioNet-11	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple Angophora floribunda, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.	**Low**. Suitable foraging habitat for the species occurs within the Study Area, but no breeding habitat. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Sooty Owl (*Tyto tenebricosa*)	V	-	BioNet-1	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata, even recorded feeding on ground. Roosts in tree hollow or dense canopy vegetation. Also nests in large Eucalypt tree hollows.	**Low**. Suitable foraging habitat for the species occurs within the Study Area, but no breeding habitat. Therefore, this species is considered to have low likelihood of occurring.
Speckled Warbler (*Chthonicola sagittata*)	V	-	BioNet-5	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	**Moderate**. Suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have moderate likelihood of occurring.
Regent Honeyeater (*Anthochaera phrygia*)	CE	CE	BioNet – 1 PMST-K	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	**Moderate**. Suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have moderate likelihood of occurring.
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	V	-	BioNet – 1	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	**Low**. Limited suitable foraging habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	BioNet-13	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	**Low**. Limited suitable foraging habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	V	-	BioNet-4	The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath.	**Moderate**. Suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have moderate likelihood of occurring
Flame Robin (*Petroica phoenicea*)	V	-	BioNet-1	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Mammals					
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	E	BioNet-1 PMST-K	Found in a variety of forested habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally, does not occur in otherwise suitable habitats that are in close proximity to urban development.	**Low**. Limited suitable foraging habitat for the species occurs within the Study Area, but no suitable roosting areas. Therefore, this species is considered to have low likelihood of occurring.
Koala (combined populations of Qld, NSW and the ACT) (*Phascolarctos cinereus*)	V	V	BioNet-1 PMST-K	Occurs in forests and woodlands where it requires suitable feed trees (particularly *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions.	**Low**. Suitable foraging habitat for the species occurs within the Study Area, but given the highly disturbed landscape the species would not have suitable connectivity to move across the landscape. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Brush-tailed Rock-wallaby (*Petrogale penicillata*)	E	V	PMST-M	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. The majority of populations favour north-facing aspects, but some southern aspects have been recorded. Apart from the critical rock structure, Brush-tailed Rock-wallaby also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest. They also require suitable caves and rocky overhangs for shelter and also for 'lookout' posts.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Greater Glider (*Petauroides Volans*)	-	V	PMST - L	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands. The broad extent of occurrence is unlikely to have changed appreciably since European settlement. However, the area of occupancy has decreased substantially mostly due to land clearing. This area is probably continuing to decline due to further clearing, fragmentation impacts, fire and some forestry activities. Kearney et al. (2010) predicted a 'stark' and 'dire' decline ('almost complete loss') for the northern subspecies P. v. minor if there is a 3 °C temperature increase. An arboreal, nocturnal marsupial largely restricted to Eucalypt forests and woodlands with a diet of eucalypt leaves and occasionally flowers. Found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows although, distribution may be patchy, even in suitable habitat. Favours forests with a diversity of eucalypt species due to seasonal variation in its preferred tree species. Shelters in tree hollows during the day. Home ranges are typically 1-4 ha.	**Low**. Limited suitable foraging habitat for the species occurs within the Study Area, but no suitable roosting/breeding habitat. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Squirrel Glider (*Petaurus norfolcensis*)	V	-	BioNet-3	Occurs in eucalypt forests and woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. This species also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species.	**Low**. Limited suitable foraging habitat for the species occurs within the Study Area, but no suitable roosting/breeding habitat. Therefore, this species is considered to have low likelihood of occurring.
Yellow-bellied Glider (*Petaurus australis*)	V	-	BioNet-1	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	**Low**. Limited suitable foraging habitat for the species occurs within the Study Area, but no suitable roosting/breeding habitat. Therefore, this species is considered to have low likelihood of occurring.
New Holland Mouse (*Pseudomys novaehollandiae*)	-	V	PMST-K	This species has a patchy distribution within open woodlands, heathlands and in hind dune vegetation throughout Eastern Australia.	**Low**. Limited suitable habitat for the species occurs within the Study Area, given the location of the study Area and the lack of connectivity values, the species is considered to have low likelihood of occurring.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	BioNet – 306 PMST-K (Roosting)	This species forages over a large area for nectar/fruits. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforests. Frequently observed to forage in flowering Eucalypts.	**Low**. Seasonal suitable foraging habitat for the species occurs within the Study Area, but no suitable roosting/breeding habitat. Therefore, this species is considered to have low likelihood of occurring.
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V	-	BioNet-1	Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	**Low**. suitable foraging habitat for the species occurs within the Study Area, however limited tree-hollows were recorded. Therefore, this species is considered to have low likelihood of occurring.
Little Bent-winged Bat (*Miniopterus australis*)	V	-	BioNet-2	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat.	**Low**. suitable foraging habitat for the species occurs within the Study Area, however no suitable breeding habitat occurs. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Large Bent-winged Bat (*Miniopterus orianae oceanensis*)	V	-	BioNet-30	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat.	**Low**. suitable foraging habitat for the species occurs within the Study Area, however no suitable breeding habitat occurs. Therefore, this species is considered to have low likelihood of occurring.
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	V	-	BioNet-23	This species is distributed south of Sydney extending north into south-eastern Queensland. There are no records west of the Great Dividing Range. Most records of this species have been reported from dry Eucalypt forest and woodland. It is expected that open forested areas and the cleared land adjacent to bushland, constitutes important habitat for this species. It is a predominantly tree-dwelling species, roosting in hollows or behind loose bark in mature Eucalypts.	**Moderate**. suitable foraging habitat for the species occurs within the Study Area, as well as roosting habitat in decorticating bark. Therefore, this species is considered to have moderate likelihood of occurring.
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V	-	BioNet-6	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows and caves. Appears to locally favour upland habitats.	**Low**. suitable foraging habitat for the species occurs within the Study Area, however no suitable breeding habitat occurs. Therefore, this species is considered to have low likelihood of occurring.
Southern Myotis (*Myotis macropus*)	V	-	BioNet-15	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines and disused railway tunnels.	**Moderate**. suitable foraging habitat for the species occurs within the Study Area, as well as potential roosting habitat in road bridge. Therefore, this species is considered to have moderate likelihood of occurring.
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	-	BioNet-9	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	**Moderate**. suitable foraging habitat for the species occurs within the Study Area, as well as potential roosting habitat in man-made structures (e.g. buildings). Therefore, this species is considered to have moderate likelihood of occurring.
Flora					

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Acacia bynoeana (Bynoe's Wattle)	E	V	BioNet -1 PMST-K	Small, prostrate shrub found in low heath, open woodland, dry sclerophyll, generally on loamy clays and sand. Occurs from the Lower Hunter south to the Southern Highlands. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	**Low**. Limited suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Acacia pubescens (Downy Wattle)	V	V	BioNet-1 PMST-K	Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. 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**. Limited suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Allocasuarina glareicola	E	E	BioNet – 1 PMST-K (Migration)	Grows in Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis*, *Eucalyptus fibrosa, Angophora bakeri*, *Eucalyptus sclerophylla* and *Melaleuca decora*. Common associated understorey species include *Melaleuca nodosa*, *Hakea dactyloides*, *Hakea sericea, Dillwynia tenuifolia*, *Micromyrtus minutiflora, Acacia elongata*, *Acacia brownei*, *Themeda australis* and *Xanthorrhoea minor*.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Cynanchum elegans (White-flowered Wax Plant)	E	E	PMST-L	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Dillwynia tenuifolia	V	-	BioNet-312	In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	**Low**. Limited suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Eucalyptus aggregata (Black Gum)	V	V	PMST-M	Grows in the lowest parts of the landscape. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (*Eucalyptus pauciflora*), Manna or Ribbon Gum (*E. viminalis*), Candlebark (E. *rubida*), Black Sallee (*E. stellulata*) and Swamp Gum (*E. ovata*). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (*Poa labillardierei*) or Kangaroo Grass (*Themeda australis*), but with few shrubs.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Genoplesium baueri (Yellow Gnat-orchid)	E	E	PMST-M	Grows in dry sclerophyll forest and moss gardens over sandstone.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Grevillea juniperina subsp. Juniperina (Juniper-leaved Grevillea)	V	-	BioNet-815	Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest. Associated canopy species within Cumberland Plain Woodland and Shale/Gravel Transition Forest include *Eucalyptus tereticornis, E. moluccana, E. crebra, E. fibrosa and E. eugenioides*. Understorey species include *Bursaria spinosa, Dillwynia sieberi, Ozothamnus diosmifolius, Daviesia ulicifolia, Acacia falcata, Acacia parramattensis, Themeda australis, Aristida ramosa, Cymbopogon refractus, Eragrostis brownii, Cheilanthes sieberi, Dianella revoluta* and *Goodenia hederacea*.	**Moderate**. suitable habitat for the species occurs within the Study Area, the species has been found in disturbed areas in Western Sydney. Therefore, this species is considered to have moderate likelihood of occurring. The species was not recorded during surveys.
Haloragis exalata subsp. *exalata* (Wingless Raspwort)	V	V	PMST-M	Square Raspwort appears to require protected and shaded damp situations in riparian habitats.	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Hibbertia puberula	E	-	BioNet-3	Flowering time is October to December, sometimes into January. Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. One of the recently described subspecies also favours upland swamps.	**Low**. Limited suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Marsdenia viridiflora subsp. viridiflora	EP	-	BioNet-955	Grows in vine thickets and open shale woodland.	**Low**. Limited suitable habitat for the species occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Melaleuca deanei (Deane's Melaleuca)	V	V	PMST-M	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Micromyrtus minutiflora	E	V	PMST-K	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the Central Coast areas. The species grows in heath on sandstone	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Persicaria elatior (Knotweed)	V	V	PMST-M	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Persoonia hirsuta (Hairy Geebung)	E	E	PMST-L	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Persoonia nutans (Nodding Geebung)	E	E	BioNet-23 PMST-K	Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Southern populations also occupy tertiary alluvium, but extend onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest.	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Pimelea curviflora var. *curviflora*	V	V	PMST-M	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Pimelea spicata (Spiked Rice-flower)	E	E	BioNet-415 PMST-K	The Illawarra populations usually occur in one of two communities - a woodland or a coastal grassland. Woodland sites are dominated by forest red gum (*E. tereticornis*) and stringybark (*E. eugenioides*), with a groundcover dominated by kangaroo grass (*Themeda australis*) and matrush (*Lomandra longifolia*). The grassland sites are dominated by kangaroo grass (*Themeda australis*) and matrush (*Lomandra longifolia*), with blady grass (*Imperata cylindrica*). A shrubby layer, where present, is dominated by coastal wattle (*Acacia sophorae*) and coast rosemary (*Westringia fruticosa*) with coast banksia (*Banksia integrifolia*).	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.
Pomaderris brunnea (Brown Pomaderris)	E	V	PMST-M	Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. The species has been found in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*.	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Pterostylis saxicola (Sydney Plains Greenhood)	E	E	PMST-L	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Pultenaea parviflora	E	V	BioNet-403 PMST-K	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. *Eucalyptus fibrosa* is usually the dominant canopy species. *Eucalyptus globoidea, E. longifolia, E. parramattensis, E. sclerophylla and E. sideroxylon* may also be present or co-dominant, with *Melaleuca decora* frequently forming a secondary canopy layer.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Rhizanthella slateri (Eastern Underground Orchid)	V	E	PMST-M	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Rhodamnia rubescens (Scrub Turpentine)	CE	CE	PMST - M	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	BioNet-1 PMST-M	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.	**None**. No suitable habitat for the species occurs within the Study Area. Therefore, this species is considered unlikely of occurring.
Thesium australe (Austral Toadflax)	V	V	PMST-M	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis).	**Low**. Limited suitable habitat for the species occurs within the Study Area, particularly in the riparian corridor. Therefore, this species is considered to have low likelihood of occurring. The species was not recorded during surveys.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Migratory Species					
Fork-tailed Swift (*Apus pacificus*)	-	C, J, K	PMST-L	In NSW, the Fork-tailed Swift is recorded in all regions. It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	**None**. The species is migratory and no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Oriental Cuckoo (*Cuculus optatus*)	-	C, J, K	PMST-K	Non-breeding habitat only: monsoonal rainforest, vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands. Frequently at edges or ecotones between habitat types. Riparian forest is favoured habitat in the Kimberley region.	**None**. The species is migratory and no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
White-throated Needletail (*Hirundapus caudacutus*)	-	V, C, J, K	PMST-K	As above.	**None**. The species is migratory and no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Black-faced Monarch (*Monarcha melanopsis*)	-	Bonn	PMST-K	Wet forest specialist, found mainly in rainforest and wet sclerophyll forest, especially in sheltered gullies and slopes with a dense understorey of ferns and/or shrubs.	**None**. The species is migratory and no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Yellow Wagtail (*Motacilla flava*)	-	C, J, K	PMST-L	Non-breeding habitat only: mostly well-watered open grasslands and the fringes of wetlands. Roosts in mangroves and other dense vegetation.	**None**. The species is migratory and no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Satin Flycatcher (*Myiagra cyanoleuca*)	-	Bonn	PMST-K	Eucalypt forest and woodlands, at high elevations when breeding. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland types. During migration, habitat preferences expand, with the species recorded in most wooded habitats except rainforests. Wintering birds in northern Qld will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps.	**Low**. The species is migratory and limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Rufous Fantail (*Rhipidura rufifrons*)	-	Bonn	PMST-L	Moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands.	**Low**. The species is migratory and limited suitable habitat occurs within the Study Area. Therefore, this species is considered to have low likelihood of occurring.
Common Sandpiper (*Actitis hypoleucos*)	-	Bonn, C, J, K	PMST-L	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Sharp-tailed Sandpiper (*Calidris acuminata*)	-	Bonn, C, J, K	PMST-K	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Curlew Sandpiper (*Calidris ferruginea*)	E	CE, Bonn, C, J, K	PMST-L	As above.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Pectoral Sandpiper (*Calidris melanotos*)	-	Bonn, J, K	PMST-M	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.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.

Species / Population / Ecological Community Name	FM Act / BC Act	EPBC Act	Source	Habitat / Community Description	Likelihood of Occurrence
Latham's Snipe (*Gallinago hardwickii*)	-	Bonn, J, K	PMST-L	Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Eastern Curlew (*Numenius madagascariensis*)	-	CE, Bonn, C, J, K	PMST-M	As above.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Eastern Osprey (*Pandion haliaetus*)	V	Bonn	PMST-M	Total range of this species is from Esperance in Western Australia to NSW and into Victoria and Tasmania. In some states (Victoria and Tasmania and southern NSW) the species is a rare vagrant. The only single historical breeding record in NSW is from the St. Georges Basin. Occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Mostly found in coastal areas but occasionally travel inland along major rivers.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.
Common Greenshank (*Tringa nebularia*)	-	Bonn, C, J, K	PMST-L	It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms.	**None**. The species is migratory and coastal, with no suitable habitat occurs within the Study Area. Therefore, this species is not considered likely of occurring.

APPENDIX B

CUMBERLAND PLAIN WOODLAND

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B.1 BC Act: Cumberland Plain Woodland and Remnant/Paddock Trees

The threatened ecological community (TEC) of name Cumberland Plain Woodland in the Sydney Basin Bioregion (Cumberland Plain Woodland or CPW hereafter) is listed as a Critically Endangered Ecological Community (CEEC).

Patches of the CPW were recorded within the Study Area (see **Section 3.1.1**). Also, patches of remnant trees and paddock trees located in an otherwise cleared land with exotic groundcover were found within the Study Area. Those patches of remnant trees and paddock trees include species of trees which are part of the assemblage of species that made up the CPW, but no other native element is present there. An assessment was made regarding remnant trees and paddock trees considered part of the BC Act listed CPW (see **Table B-1**). The Final Determination for the BC Act listed CEEC (NSW TSSC 2010) indicates that CPW can occur with varying structure as:

- Canopy + Groundcover
- Canopy + Groundcover + Shrub and/or Small trees
- Groundcover (i.e. Derived Native Grassland)

Therefore, canopy only would not meet the structure requirements for CPW. However, the Final Determination indicates that the composition of species in a given stratum would vary, and that although a species might be absent in a given stratum due to disturbance (e.g. clearing) the possibility that the species might be present in the soil seed-bank exists. The latter argument has resulted in differing interpretations on whether or not canopy only would conform to the TEC if the likelihood of native seed in the soil seed-bank is accounted for. It was concluded that the final determination for listing of the CPW in the state of NSW is uncertain regarding inclusion of remnant trees and/or paddock trees as part of the TEC due to varying interpretation of the Final Determination as a whole. Therefore, clarification has been sought from the NSW Threatened Species Scientific Committee regarding remnant and paddock trees and their correspondence to the BC Act listed CPW. The NSW TSSC response via its mailbox indicated that such clarification was outside the main function of the TSSC, therefore a response was provided by the Accountability Officer for CPW whose response states:

"*Within item 17 of the determination it specifically mentions this as 'Large trees approximating the stature of the community prior to European settlement occur very sparsely within remnant patches of vegetation or remain as isolated individuals within paddocks or urban areas.'. Therefore, isolated remnant or individuals do form part of the community. Furthermore, although the seed bank may be severely disturbed, there is still likelihood that native species are retained and may regrow with reduced maintenance. Other components of the community such as 'micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate' are likely to occur*."(email response from NSW TSSC's Accountability Officer for CPW on 27 July 022).

Based on the NSW TSSC's Accountability Officer, paddock and remnant trees of species part of the assemblage listed in the Final Determination of the BC Act listed CPW are, therefore, accounted for as part of the CPW CEEC. In the present BAR, remnant trees and paddock trees had been mapped as PCT 849_Remnant Trees.

Table B-1. Final Determination of Cumberland Plain Woodland (CEEC) regarding remnant and paddock trees inclusion in the BC Act listed TEC

No	CPW Final Determination (NSW Threatened Species Scientific Committee 2010)	Remnant tree area in Dunheved Road Study Area
1	Cumberland Plain Woodland was listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995* in June 1997 (NSW Scientific Committee 1997). Since this listing, a large volume of new data and analyses have become available. In addition, a nomination to change the status of Cumberland Woodland to Critically Endangered status has been received. This Determination addresses additional information now available in accordance with current listing criteria under the *Threatened Species Conservation Regulation 2002*	The Final Determination for CPW up-listing from Endangered Ecological Community (EEC) to Critically Endangered Ecological Community (CEEC) was gazetted on 18 December 2009.
2	Cumberland Plain Woodland is the name given to the ecological community in the Sydney Basin bioregion associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain, a rainshadow area to the west of Sydney's Central Business District. The mean annual rainfall of this area is typically in the range of 700-900 mm, and is generally lower than that received on more elevated terrain that partially surrounds the Plain. The community typically occurs on flat to undulating or hilly terrain up to about 350 m elevation but may also occur on locally steep sites and at slightly higher elevations.	Dunheved Road project is located in the Cumberland IBRA subregion and the geology map indicates that clays part of the Wianamatta group occur.
	Cumberland Plain Woodland is characterised by the assemblage of species listed in paragraph 3 and typically comprises an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees. Shrubs may sometimes occur in locally dense stands.	The paddock and remnant trees object of this assessment occur in an otherwise cleared environment with exotic grasses and herbs in the ground layer which is maintained (i.e. mowed) by the local Council. The tree species include *Eucalyptus molucana*, *Eucalyptus tereticornis* and *Angophora floribunda*. No native component occurs in the ground layer. No shrub layer is present. This paragraph of the FD suggest that the TEC can occur with the following variations in structure: ▪ Canopy + groundcover ▪ Canopy + groundcover + shrub and/or small trees But it does not suggest that the TEC occurs as only canopy. The extant of CPW in the Cumberland Plain mapped by NSW NPWS (2002) included vegetation zones where only remnant / paddock trees occur in patches >0.5ha and <10% crown cover projection density (CCPD) in aerial image analysis (i.e. the scattered tree condition classes Tx (tree cover only with agriculture but no major urban or suburban development), Txr (tree cover only with rural residential development), Txu (tree cover only with urban development)). Remnant and paddock tree patches in the Dunheved Road Upgrade Study Area are small (<0.5 ha). It is worth noticing that in identifying priority conservation lands as part of the Cumberland Plain Recovery Plan (DECCW 2010), identification of extant of TECs, including CPW, excluded all scattered tree condition classes mapped (i.e. Tx, Txr and Txu). This was the case as remnant,

No	CPW Final Determination (NSW Threatened Species Scientific Committee 2010)	Remnant tree area in Dunheved Road Study Area
		scattered or paddock trees without any other native component do not represent good opportunity to secure viable, long-term conservation outcomes for vegetation communities due to the poor condition of the vegetation they were once part of.
	Less disturbed stands of the community may have a woodland or forest structure.	-
	Small trees or saplings may dominate the community in relatively high densities after partial or total clearing, and the groundcover may be relatively sparse, especially where densities of trees or shrubs are high.	None present.
	The community also includes 'derived' native grasslands which result from removal of the woody strata from the woodlands and forests	This sentence indicates that the TEC can occur with a simpler structure: ▪ Groundcover Therefore, Derived Native Grasslands (DNG) would be part of the TEC. It is noted that, no native component occurs at base of the remnant and paddock trees assessed here and part of the Dunheved Road Study Area.
3	List of characteristic and less frequent species	The tree species include *Eucalyptus molucana*, *Eucalyptus tereticornis* and *Angophora floribunda*.
4	The total species list of the community is larger than that given above, with many species present in only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including grazing, land clearing and fire) history. The number and relative abundance of species will change with time since fire, and may also change in response to changes in fire frequency or grazing regime.	Area is maintained by council (exotic lawn) and only trees present. The remnant and paddock trees are adjacent to Dunheved Road, it is likely that no fires had occur in the exotic lawn in recent years.
	At any one time, above-ground individuals of some species may be absent, but the species may be represented below-ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers.	A Senior Biodiversity Officer from the local Council indicated to be a local resident and based on her local knowledge, it is known that the roadside land where the remnant and paddock trees occur has been maintained (i.e. mowed) for at least the last 13 years. It is unknown, however, for how many years prior to the local Council staff residence within the Study Area has the land being maintained. Information on the longevity and viability of seed in soil for species in the CPW is not readily available. Hill and French (2003) undertook a study on soil seed-bank in CPW and its response to heating, they found that after applying heat to soils from a CPW location, the number of species which germinated from soil seed-bank and the proportion of species were similar to the proportions of species surveyed in the above-ground vegetation, suggesting that the soil seed-bank reflected the current structure of vegetation although species composition differed. Hill *et. al*. (2005) indicated that disturbances, such as clearing and roads, favour establishment of exotic plants in CPW. Cleared/grazed

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		CPW adjacent to sealed roads had the highest invasion of exotics, compared to uncleared/grazed and uncleared/ non-grazed CPW and CPW adjacent to unsealed roads. Where exotic plants establish, these invasive species can segregate native plants and modify the soil environment (e.g. nutrients, pH) which in turn would influence recruitment of native species. The above information suggests that the soil seed-bank at sites with exotic groundcover would likely have a soil seed-bank with exotic seed and that if disturbances stop (e.g. mowing) and non-assisted revegetation is allowed to occur, exotic grassland would most likely be the resulting vegetation assemblage present in the site.
	Benson and Howell (2002) and Benson & von Richter (2008) document the temporal variability in the species composition of the community. The list of species given above is mainly of vascular plant species, however the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. The mammalian and avian components of the fauna have been described by Leary (in litt. August 2007) and Farrell (in litt. June 2007). Other components of the community are poorly documented (although see Benson & von Richter 2008).	DEC (2005) indicates that mowing can not only supress the regrowth of native plants, but that regular mowing can also deplete the native soil seed bank (in lit James 1994, Lunt 1991). In trials, it has been observed that in when mowing stops in areas that had been mowed for many years, regeneration of native species can occur (lit McDonald 1996, James 1994) In James (1994), Gum Tree Reserve, a 0.75ha Council maintained reserve isolated by urban development consisting of Turpentine-Ironbark Forest with re-growth native trees and poorly developed understorey (small trees, shrubs, exotic species and Council planted natives) due to mowing. The vegetation was monitored one year after stopping frequent mowing and the vegetation included three times the number of native herbs, subshrubs and climbers. Only 37% of native species present in a nearby vegetated area along a pipeline, the author suggest that lack of woody plants recruitment might be associated with long life cycle, that the presence of herbs and forbs could have been due to significant potential input of seeds into the soil bank during the 12 months of change of mowing regime. It is stated that the long-term viability of seed for different species is poorly documented, but estimates for Acacia species may be as high as 50 to 100 years. How long would a seed bank be viable?
5	Cumberland Plain Woodland is characterised by an upper-storey that is usually dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Grey Ironbark), *E. eugenioides* (Narrow-leaved Stringybark), *Corymbia maculata* (Spotted Gum) or other less frequently occurring eucalypts, including *Angophora floribunda*, *A. subvelutina* (Broad-leaved Apple), *E. amplifolia* (Cabbage Gum) and *E. fibrosa* (Broad-leaved Ironbark).	Upper Storey: trees present as remnant
	The community may have an open stratum of small trees that may include any of these eucalypts, as well as species such as *Acacia decurrens* (Black Wattle), *A. parramattensis* (Parramatta Wattle), *A. implexa* (Hickory Wattle) or *Exocarpos cupressiformis* (Native Cherry). Shrubs are typically scattered in the understorey but may be absent or locally dense as a	Mid storey: absent

No	CPW Final Determination (NSW Threatened Species Scientific Committee 2010)	Remnant tree area in Dunheved Road Study Area
	result of clearing activity or changes in grazing or fire regimes. *Bursaria spinosa* (Blackthorn) is usually dominant, while other species include *Daviesia ulicifolia* (Gorse Bitter Pea), *Dillwynia sieberi*, *Dodonaea viscosa* subsp. *cuneata* and *Indigofera australis* (Native Indigo).	
	The ground cover is dominated by a diverse range of grasses including *Aristida ramosa* (Purple Wiregrass), *A. vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass), *Dichelachne micrantha* (Plumegrass), *Echinopogon caespitosus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass), and with graminoids *Carex inversa* (Knob Sedge), *Cyperus gracilis*, *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush) and *L. multiflorus* subsp. *multiflorus* (Many-flowered Mat-rush). The ground cover also includes a diversity of forbs such as *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Dianella longifolia* (Blue Flax Lily), *Dichondra repens* (Kidney Weed), *Opercularia diphylla*, *Oxalis perennans* and *Wahlenbergia gracilis* (Australian Bluebell), as well as scramblers, *Glycine* spp. and *Hardenbergia violacea* (Native Sarsaparilla) and the fern *Cheilanthes sieberi* (Poison Rock Fern).	Ground cover: native ground cover is absent
6	The structure of the community varies depending on past and current disturbances, particularly clearing, fire and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover.	The remnant trees occur in a historically cleared area. No native shrub or groundcover is present.
	At some sites, mature trees may exceed 30m tall, although regrowth stands may be shorter than 10 m tall. After total or partial clearing, the tree canopy may remain sparse or may regrow to form dense stands of saplings and small trees, which are typically associated with a ground layer of reduced cover and diversity.	Trees are most likely re-growth, no saplings, no small trees, no native ground layer occurs.
	Either or both of the upper-storey and mid-storey may be absent from the community. Native grasslands derived from clearing of the woodland and forest are also part of this community if they contain characteristic non-woody species listed in paragraph 3.	Based on these last sentences, I gather that the community is to have native ground-cover and can occur as: a) Canopy, mid-layer & ground cover b) Mid-layer & ground cover c) Ground cover (i.e. Derived Native grasslands) But a patch of native canopy without mid-layer and ground cover would not conform the TEC.
7	Cumberland Plain Woodland includes: 'Shale Hills Woodland' (map unit 9) and 'Shale Plains Woodland' (map unit 10) of Tozer (2003); 'Spotted Gum Forest' (map unit 9b), 'Grey Box Woodland' (map unit 10c) and 'Grey Box – Ironbark Woodland' (map unit 10d) of Benson (1992); and 'Cumberland Plain Woodlands' of Benson & Howell (1990a; b). Tindall et al. (2004) and Tozer et al. (2006) subsequently reproduced Tozer's (2003) classification and mapping, re-labelling map units 9 and 10 as 'Cumberland Shale Hills Woodland' (map unit GW p28) and 'Cumberland Shale Plains Woodland' (map unit GW p29), respectively. Cumberland Plain Woodland belongs to the Coastal Valley Grassy Woodlands vegetation class (Keith 2004).	PCT 849 corresponds to Cumberland Shale Plains Woodland (map unit GW p29, Tozer et al 2010)

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8	Several other ecological communities listed under the *Threatened Species Conservation Act 1995* may intergrade with Cumberland Plain Woodland. These include Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion; Moist Shale Woodland in the Sydney Basin Bioregion; Shale / Sandstone Transition Forest; Shale Gravel Transition Forest in the Sydney Basin Bioregion; and Sydney Turpentine-Ironbark Forest. While Tozer (2003) provides information on the features that distinguish these communities, some transitional stands will be difficult to assign to a single community with a high level of confidence (Keith 2009). Transitional stands between Cumberland Plain Woodland and other communities listed under the *Threatened Species Conservation Act 1995* are considered part of a listed community, and should be assigned to the community with which they share greatest resemblance in species composition and other properties	Not applicable
9	Cumberland Plain Woodland in the Sydney Basin Bioregion is included within the critically endangered ecological community listed under the *Environment Protection and Biodiversity Conservation Act* as "Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest". However the Commonwealth listing advice excludes some patches, here regarded as Cumberland Plain Woodland, on the basis of condition or structure thresholds.	Patch of native trees do not meet the EPBC Act TEC. EPBC Act listed TEC: "*The ecological community may have an upper tree layer, lower tree layer, shrub layer and a ground layer though in any given patch one or more layers may be absent or depauperate. For the purposes of listing under the EPBC Act, the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest always has upper tree layer species present and either a shrub or ground layer present*"
10	The following threatened species have been recorded from Cumberland Plain Woodland [list given in FD]	Remnant trees include species of trees listed in the Final Determination.
11	Cumberland Plain Woodland is restricted to the Sydney Basin Bioregion (sensu Thackway and Cresswell) and is currently known to occur within the local government areas of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly, but may occur elsewhere within the bioregion. Using map data from Tozer (2003), Cumberland Plain Woodland was estimated to occur within an extent of occurrence of 2810 km2, and an area of occupancy of just under 2 100 km2 based on 2 x 2 km grid cells, the spatial scale recommended by IUCN (2008) for assessing areas of occupancy for species.	The Study Area is within the Penrith LGA.
12	Small areas of Cumberland Plain Woodland have been recorded from Kemps Creek, Mulgoa and Windsor Downs Nature Reserves, Scheyville National Park, and Leacock, Rouse Hill and Western Sydney Regional Parks	Not applicable
13	Based on aerial photography flown in November 1998, Tozer (2003) estimated the total extent of woody vegetation referred to as Cumberland Plain Woodland was 11 054 (±1 564) ha (upper and lower plausible bounds, sensu Keith et al. 2009), representing 8.8 (±1.2)% of the pre-European distribution of the community. Patches of the community lacking woody vegetation are very small in extent and can be considered to be included within the plausible bounds. For that part of the community's distribution to the east of the Hawkesbury-Nepean River, earlier mapping at coarser resolution by Benson & Howell (1990b) suggests a similar level of depletion, with an estimated 6 420 ha of 'Cumberland Plain Woodlands', representing 6% of the pre-European distribution east of the Hawkesbury-Nepean River. An update of Tozer's (2003) map, based on interpretation of imagery flown in January-March 2007 shows	The estimated extant of CPW by Tozer, corresponds to the 11,054.5 ha of native vegetation patches of CPW estimated by NPWS (2002). In addition to patches of native vegetation, NPWS (2002) estimated that 17,120.5 ha of canopy were CPW occurring as scattered trees. The estimation of Tozer (2003) referred to in the Final Determination, suggest that scattered trees might have not being considered as CPW.

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	that the extent of Cumberland Plain Woodland east of the Hawkesbury – Nepean River had declined by 442±46 ha, a reduction of 5.2±0.6% in 9 years (NSW Scientific Committee & Simpson 2008). These estimates indicate that the geographic distribution of the community has undergone a very large reduction over a time frame appropriate to the life cycle and habitat characteristics of its component species.	
14	Some areas of Cumberland Plain Woodland subjected to a history of partial clearing and grazing have recently undergone a change in management to conserve the community. Examples include Mt Annan Botanic Garden, Scheyville National Park, Western Sydney Regional Park, Elizabeth Macarthur Agricultural Institute, Orchard Hills Defence Site and the former Australian Defence Industries site at St Marys.	History of the Study Area regarding clearing, whether it was partial or total, is not available. The presence of remnant trees, suggest that the trees might have been protected during construction. It is considered that the shrub and groundcover layers would have possibly undergone total clearing in areas immediately adjacent to Dunheved Road, where access by machinery/vehicles, earthworks for kerb construction and laydown areas use during construction cannot be precluded.
	Experience from these areas suggests that the community is capable of some recovery, provided the soil has not been disturbed by earthworks, cultivation, fertiliser application or other means of nutrient or moisture enrichment (Benson & Howell 2002; Pellow 2003; Keith et al. 2005; J. Howell in litt. August 2007; J. Sanders in litt. January 2008).	It is unknown if soil disturbance occurred in remnant patch areas within the Study Area, although it is expected that some level of earthworks and soil disturbance occurred during construction of the existing Dunheved Road because the remnant trees are within 5m form the road's edge. Penrith Council would have the opportunity to change regime of mowing in lands where remnant trees occur adjacent to roads and assess the potential of recovery of CPW (e.g. James 1994). It would be important to asses whether isolated patches of remnant trees recover as an assemblage of CPW or reflect the native planted and exotic plants present in the immediate locality.
	In contrast, restoration of Cumberland Plain Woodland has proved to be problematic on sites that have been exposed to such soil disturbance. At Western Sydney Regional Park, for example, Wilkins et al. (2003), Nichols (2005) and Nichols et al. (2005) studied the recovery of abandoned pastures that had been planted with more than 20 native tree and shrub species of Cumberland Plain Woodland. Over 10 years they found no evidence of convergence in species composition with nearby remnant stands of the community and the species composition of restored areas remained indistinguishable from untreated pastures. There was some evidence that restored vegetation had begun to develop more species-rich assemblages of moths and butterflies compared to untreated pastures, although after 10 years, it lacked a number of species characteristic of remnant woodland (Lomov et al. 2006). Ant communities also showed marked differences between restored and remnant vegetation although some ecological processes, such as pollination and seed dispersal, showed some evidence of development at restored sites (Lomov 2005). These results suggest that sites with a history of soil disturbance will be extremely slow to recover characteristics of Cumberland Plain Woodland, if at all, and that experimentation with alternative restoration technologies is required. As a large proportion of the former distribution of the community has either undergone similar histories of soil disturbance or are now occupied by urban development, opportunities for restoration of the community across significant areas appear limited	Restoration of CPW in patches of remnant trees adjacent to roads where the exotic groundcover is mowed is required to know if a native ground and shrub layer develop and if those layers would reflect CPW. At the time this assessment was prepared, no such evidence was found in published literature for CPW.

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15	The reduction in the geographic distribution of Cumberland Plain Woodland was initially due to tree-felling for timber and clearing for crops and pastures (Benson & Howell 1990a). Benson & Howell (1990b) estimated that the community had been reduced to approximately half of its pre-European extent by 1850. Following World War II, there was a marked acceleration in urban and industrial development, which continues to deplete the distribution of the community to the present day. These trends appear likely to continue into the future as the urban area continues to expand to accommodate Sydney's increasing population, which is projected to grow by 1.0-1.1 million people during the 20 years 2007-2026 and 2.2-3.3 million during the 50 years 2007-2056 (Australian Bureau of Statistics 2008). Recent draft plans to develop growth centres in north-west and south-west Sydney, for example, identify staged release of land for residential and employment development over the next 25 years. These areas contain approximately 2000 ha (one-fifth) of the estimated remaining Cumberland Plain Woodland based on Tozer (2003), of which about two-thirds will be available for development, the loss of which is planned for offsetting through voluntary land acquisition and/or the establishment of conservation agreements on lands outside the Growth Centres (Growth Centres Commission 2007) for the primary purpose of biodiversity conservation. While important examples of Cumberland Plain Woodland are represented within conservation reserves, much of the remaining area of the community occurs on private land or on public easements, where it is at risk from small-scale clearing associated with housing, industrial development and transport infrastructure. There are significant logistic and technological constraints and time lags associated with efforts to restore the community (Wilkins et al. 2003; Nichols 2005; Nichols et al. 2005). 'Clearing of native vegetation' is listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995*.	-
16	Fragmentation of habitat associated with clearing has resulted in a very large reduction in the ecological function of Cumberland Plain Woodland. 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 ha and half of all mapped patches being smaller than 3 ha (Tozer in litt. October 2007). 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). The impacts of fragmentation and associated processes are most evident in the loss of vertebrate fauna from the community (Farrell 2005; Farrell in litt. June 2007; Leary 2005; in litt, August 2007). As well, some invertebrate species, such as the Endangered Cumberland Land Snail, appear to be in decline, at least in the smaller fragments (M. Shea in litt. June 2007). The dieback of eucalypt canopies observed in stands of Cumberland Plain Woodland at Scheyville (D. Keith pers. comm. October 2008) may be a result of complex interactions involving insect attack, weed invasion, nutrient enrichment and drought, in which fragmentation also plays a role (Reid & Landsberg 2000; Wardell-Johnson et al. 2006). Despite their history of fragmentation, some very small and apparently degraded remnants may contain a surprisingly high diversity of species and important examples of rare species, particularly plants (James et al. 1999; Benson & Keith 1984; McBarron et al. 1988; Benson & Howell 1990a; Kirkpatrick & Gilfedder 1995). However, clearing and continuing degradation of these patches reduces the likelihood	Isolated fragments of CPW would have reduced ecological function, a patch of trees with no other native component do not conform a vegetation community nor do they function as such

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	that all of these 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). Fragmentation also results in reduced fire frequencies within some patches, which may reduce the viability of some native plant populations, and hence the diversity of species within the patches (Clarke 2000; Watson 2005)	
17	Changes in structure contribute to a very large reduction in the ecological function of Cumberland Plain Woodland. Almost all of the remaining area of the community is regrowth forest and woodland from past clearing activities (Benson & Howell 1990a). Mean tree densities in contemporary stands of the community were found to be substantially higher than historical estimates and tree sizes were thought to be smaller (Benson 1992). Large trees approximating the stature of the community prior to European settlement occur very sparsely within remnant patches of vegetation or remain as isolated individuals within paddocks or urban areas. Scheyville National Park, for example, which contains a large remnant of Cumberland Plain Woodland, was extensively logged and partially cleared over many decades prior to its reservation and is thought to contain as few as five large old trees likely to date from pre-European times (J. Sanders, in litt. January 2008). Loss of these large trees, which provide habitat resources for a range of fauna, is associated with declines and local extinctions of numerous birds and mammals that were once more common on the Cumberland Plain (Farrell 2005; T. Leary in litt. August 2007). Changes in understorey are difficult to assess, as responses to anthropogenic disturbances are confounded with responses to climatic variability (Benson & Howell 2002). Nevertheless, other structural changes to the community include the removal of fallen woody debris and standing dead trees, the removal of woody understorey plants, or conversely the development of regrowth stands with very high densities of eucalypt saplings or shrubs, notably Bursaria spinosa, which may suppress the ground flora. Botanist Allan Cunningham noted high densities of B. spinosa in farmland near Liverpool as early as 1817 (Lee 1927; Benson 1992), while similar phases of high shrub abundance have been observed recently at Mt Annan and Scheyville in response to abandonment of farming practices (Benson & Howell 2002; J. Sanders, in litt. January 2008). Some areas of the community now devoid of woody plant species may retain a substantial suite of native grasses and herbs in the ground layer. The Orchard Hills Defence Site includes outstanding examples of this phenomenon (Pellow 2003; Keith et al. 2005). 'Loss of hollow-bearing trees' and 'Removal of dead wood and dead trees' are listed as Key Threatening Processes under the Threatened Species Conservation Act 1995.	Furthermore, the reduction of vegetation structure to only trees is also an indication of the reduction in ecological function of a patch of native trees without another native component
18	While a sample of the original fauna of Cumberland Plain Woodland persists, some components have already been lost and others continue to decline (Leary 2005; in litt. Aug. 2008). The original mammal fauna of the Cumberland Plain was estimated to include approximately 60 species (NPWS 1997), of which less than 40 were detected in recent intensive surveys and only 14 species are now considered to be relatively common and widespread (Leary 2005; in litt. August 2008). The majority of these latter species are micro-bats, while small ground-dwelling mammals are unexpectedly scarce. A systematic survey involving 22 000 trap nights and 14 000 hair tube nights across conservation reserves containing Cumberland Plain Woodland failed to detect any native rodents or dasyurids, except at sites on the periphery of the plain, close to larger vegetated areas on sandstone	

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	(Leary 2005; in litt. August 2008). Long-nosed Bandicoots have recently been recorded in inner western Sydney (NSW Scientific Committee 2008), but remain scarce and have not been recorded during the systematic fauna surveys of Cumberland Plain Woodland. A number of bird species have also disappeared from or markedly declined on the Cumberland Plain (Keast 1995; Farrell 2005; Leary 2005; in litt. August 2008). A sequence of repeated surveys in Scheyville National Park, the largest remnant of Cumberland Plain Woodland, have documented disappearance of the Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Zebra Finch, Hooded Robin, Red-capped Robin, Scarlet Robin, Flame Robin and Black-eared Cuckoo, while declines have been observed in populations of the Speckled Warbler, Fuscous Honeyeater, Jacky Winter, Weebill and Buff-rumped Thornbill (Farrell 2005; in litt. June 2008). Repeated surveys of Nurragingy Reserve near Blacktown indicate that all of these species have also been lost from the reserve, except for the Fuscous Honeyeater and Weebill (Farrell 2005; in litt. June 2008). Many of these species either feed or nest on or near the ground. Declines of reptiles and amphibians on the Cumberland Plain have been less well documented, but include at least three species of frog, one species of turtle, one skink, possibly two species of goanna and one species of snake (Leary 2005; in litt. August 2008). Two species of plants, *Swainsona monticola* and *Thesium australe*, are presumed to have gone extinct in Cumberland Plain Woodland (Benson & Howell 2002), while James et al. (1999) list many other species that have undergone substantial declines, including threatened species such as *Acacia pubescens*, *Pimelea spicata* and *Pterostylis saxicola*. In addition to these losses and declines across a wide range of biota within the community, Benson & Howell (1990a; 2002) describe other changes in species composition that indicate a very large reduction in the ecological function of Cumberland Plain Woodland.	
19	Weed invasion also poses a major threat to Cumberland Plain Woodland. While very large numbers of weed species have invaded many different areas of the community, principal weed species include (Benson 1992; Tozer 2003; Benson & von Richter 2008): [table given in FD] Several of these species, particularly grasses, form a dense ground layer capable of smothering indigenous plants, reducing both reproduction and survival, and inhibiting emergence and establishment of their seedlings. The propagules of weeds are spread into Cumberland Plain Woodland by stormwater, dumping of refuse, frugivorous birds and wind (Benson & Howell 1990b), making it difficult to abate the invasion process, especially for those species capable of establishing in sites that have been exposed to relatively little disturbance (J. Sanders, in litt. January 2008). Hill et al. (2005) found that high species richness and abundance of weeds was associated with remnants that either had a history of clearing and grazing, were in close proximity to creeks or downslope from sealed roads. They also found some relationship between weeds and elevated total soil phosphorus, conductivity and water retention capacity, but relationships with these soil properties were weak and varied between sites with different types of disturbance history. The dramatic recent expansion of African Olive poses the greatest invasive threat to Cumberland Plain Woodland. Initially introduced to south-western Sydney in the 1820s, it was generally confined to the Camden-Picton area until the 1970s and now occurs frequently throughout the distribution of the community (Tozer 2003; Cuneo & Leishman 2006). Roberts (1999) mapped approximately 1000 ha of Cumberland	The patches of remnant trees are mowed by Penrith Council. Only small herbs and exotic grass was recorded therein. *Chloris gayana* and *Eragrostis curvula* were recorded in non-mowed areas along Dunheved Road, including within patches of CPW.

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	Plain Woodland (c. 10% of total remaining) which had a dense understorey of African Olive that was visible on aerial photographs flown in November 1997. Tozer (2003) recorded African Olive in 43% of 198 plots surveyed throughout the distribution of Cumberland Plain Woodland. Cuneo et al. (2009) found that 837 ha of Cumberland Plain Woodland in south-west Sydney was invaded by African Olive (8.5% of the area assessed). The species is highly fecund, with fleshy fruit spread widely by a range of frugivorous birds, and seedlings establish readily in relatively undisturbed bushland, as well as fragmented edges (Cuneo & Leishman 2006). As shrubs grow, their canopies cast deep shade and suppress and ultimately eliminate most native shrub and groundcover species. Cook et al. (2005) and Tozer (in litt. October 2007, based on data from Tozer 2003), both recorded strong inverse relationships between the cover abundance of African Olive and the diversity and cover of native ground layer species. Other weeds that pose future threats to the community include Ailanthus altissima, Asparagus asparagoides, Acer negundo, Gleditsia triacanthos and Macfadyena unguis-cati (Benson & Howell 2002; J. Howell in litt. August 2007; J. Sanders in litt. January 2008; L. Harrold pers comm. 2009). The invasion and establishment of exotic weeds is resulting in a very large reduction in the ecological function of Cumberland Plain Woodland. 'Invasion of exotic perennial grasses' and 'Invasion and establishment of exotic vines and scramblers' are listed as Key Threatening Processes under the Threatened Species Conservation Act 1995.	
20	Moderate to heavy grazing of Cumberland Plain Woodland by livestock and rabbits results in the decline and disappearance of palatable plant species, including shrubs and herbs, and compaction and erosion of topsoil, making re-establishment of a diverse native understorey problematic. The effects of such overgrazing may be exacerbated under drought conditions. Habitat degradation associated with overgrazing and erosion contributes to a large reduction in ecological function of the community.	-
21	The soils of Cumberland Plain Woodland have undergone chemical and structural modification associated with agricultural land uses. Trampling by livestock has resulted in localised areas of soil compaction, primarily around watering points. Research carried out at the University of Western Sydney found that mean soil inorganic nitrogen levels were two to three times higher in areas of former agricultural land use than in remnant woodland, but was unable to detect differences in other soil properties (E. C. Morris in litt. June 2007). Addition of carbon and burning reduced soil inorganic nitrogen and reduced growth of exotic ground layer species relative to native species, suggesting that elevated soil inorganic nitrogen could favour exotics to the detriment of natives in Cumberland Plain Woodland (E. C. Morris in litt. June 2007). Hill et al. (2005) found elevated levels of phosphorus and conductivity in former agricultural areas compared to remnant woodland, but did not examine soil nitrogen. The sources of nutrient addition to soils of Cumberland Plain Woodland include addition of fertilisers during previous agricultural land use, deposition of livestock dung, rubbish dumping and stormwater runoff from urban areas. Expansion of urban land uses across the Cumberland Plain is likely to increase urban runoff from sealed surfaces into remaining bushland fragments, resulting in further nutrient enrichment of soils and associated replacement of native flora by exotic species. Disruption of ecological processes and degradation of habitat associated with nutrient enrichment contributes to a very large reduction in ecological function of the community.	-

No	CPW Final Determination (NSW Threatened Species Scientific Committee 2010)	Remnant tree area in Dunheved Road Study Area
22	Fire regimes influence the plant species composition and vegetation structure of Cumberland Plain Woodland (Benson & Howell 2002; Watson 2005) and are also likely to influence other components of the biota. Based on a study of Cumberland Plain Woodland remnants with varying fire histories, Watson (2005) found that variable intervals of 4 - 12 years between successive fires are likely to maintain populations of most understorey species in the community, including resprouting and obligate-seeding shrubs, grasses and herbs. Fragmentation of Cumberland Plain Woodland may exclude fire from some patches for extended periods by reducing fire spread. The consequent reduction in fire frequency sometimes leads to increased dominance of shrubs and associated declines in diversity of grasses and herbs (Watson 2005), as well as increased abundance of woody exotic species, such as African Olive (Benson & Howell 2002; Watson 2005; von Richter et al. 2005), which is likely to further reduce the flammability of the community. Conversely, high frequencies of fires may result where fragmentation increases the interface between urban areas and bushland, as this results in increased arson, car dumping, planned fuel-reduction fires and accidental ignitions. High fire frequencies are associated with reduced diversity of native plant species in Cumberland Plain Woodland (Watson 2005). 'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the Threatened Species Conservation Act 1995. The season of fire, which may be altered as a consequence of hazard reduction fires, may also influence the species composition of the grassy woodland understorey (Knox & Clarke 2006; Benson & von Richter 2008). Disruption of ecological processes associated with alteration of fire regimes contributes to a very large reduction in ecological function of the community.	The remnant and paddock trees assessed are located in the road reserve and land adjacent to the existing Dunheved Road. At the time of surveys between September 2021 and May 2022, no evidence of fire was observed in trees. Consultation with an RFS member indicated that no record of bushfires or hazard reduction fires are known along Dunheved Road for the last seven years and over (RFS member *per com* 21 July 2022).
23	Cumberland Plain Woodland in the Sydney Basin Bioregion is eligible to be listed as a Critically Endangered Ecological Community as, in the opinion of the Scientific Committee, it is facing an extremely high risk of extinction in New South Wales in the immediate future, as determined in accordance with the following criteria as prescribed by the Threatened Species Conservation Regulation 2002: **Clause 25** The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species: (a) a very large reduction in geographic distribution. **Clause 27** The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species: (a) a very large reduction in ecological function, as indicated by any of the following: (d) a change in community structure (e) a change in species composition (f) disruption of ecological processes	The Final Determination for CPW listing as CEEC was gazetted on 18 December 2009.

No	CPW Final Determination (NSW Threatened Species Scientific Committee 2010)	Remnant tree area in Dunheved Road Study Area
	(g) invasion and establishment of exotic species (h) degradation of habitat (i) fragmentation of habitat.	

APPENDIX C

ASSESSMENT OF SIGNIFICANCE

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C.1 Assessment of Significance

Where threatened species and vegetation communities are identified as likely to be impacted by a given proposal, an assessment of those impacts is undertaken to identify whether or not significant impacts are likely to occur. Requirements for assessment of significance involve several steps to identify extent of impacts on population and/or community structure and long-term survival and consist of addressing several questions. Assessments of significance as per different legislative instruments in the state of NSW include:

- Test of Significance (also known as five-part test) as detailed in Section 7.3 of the NSW *Biodiversity Conservation Act 2016*. Where significant impacts are identified, preparation of a Species Impact Statement (SIS) is triggered;
- Assessment of Significance under the NSW *Fisheries Management Act 1994*; and
- Significant Impact Assessment under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999*.

Selection of threatened species and vegetation communities for assessment of significance is based on the likelihood of occurrence (LoO) assessment and results of field surveys and vegetation ground-truthing. Where the LoO assessment identifies a threatened species or ecological community as having a moderate, high or known likely of occurrence and is likely to be impacted, an assessment of significance is undertaken.

All threatened species and vegetation communities with potential to occur within the 5km locality surrounding the Study Area were identified during database searches (i.e. BioNet Atlas and PMST report) and of LoO assessment undertaken (see **Appendix A**). A total of 11 threatened species were assessed as having a moderate likelihood of occurrence. These species are:

- Flora species: the species was not recorded during surveys. No further assessment is required.
  - Juniper-leaved Grevillea (*Grevillea juniperina subsp. juniperina*)
- Microbats: targeted surveys for these species were not undertaken, therefore, it is assumed that the species are present in suitable habitat and assessment of significance is warranted (see **Table C-1**).
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
  - Southern Myotis (*Myotis macropus*)
  - Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Woodland Birds: the species were not recorded during the site inspection. Given that targeted surveys were not undertaken, the possibility exist for the species being albeit occasionally present, therefore an assessment of significance is warranted (see **Table B-2**).
  - Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
  - Regent Honeyeater (*Anthochaera phrygia*)
  - Speckled Warbler (*Chthonicola sagittata*)
  - Diamond Firetail (*Stagonopleura guttata*)
  - Swift Parrot (*Lathamus discolor*)
  - Little Lorikeet (*Glossopsitta pusilla*)
- Land Snail: the species' shells were recorded in leaf-litter but not in paddock trees. Targeted surveys for the species were undertaken in suitable habitat in PCT 849 and PCT 835, which are potential habitat for the species. The presence of CPLS shells suggest that the species was/has been present in the location within the last two years. Therefore, an assessment of significance is warranted (see **Table C-3**).
  - Cumberland Plain Land Snail (*Meridolum corneovirens*)

Two TECs were recorded within the Study Area Cumberland Plain Woodland and River-flat eucalypt forest, respectively.

- Cumberland Plain Woodland:
  - BC Act Name: Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)
  - EPBC Act name: Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CEEC)

- River-flat Eucalypt Forest:
  - River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC)
  - EPBC Act name: River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC).

C.2 Test of Significance (BC Act)

Table C-1 to **Table C-3** provide five-part tests assessing likelihood of significant impact on the above identified threatened species (listed under the BC Act) requiring assessment.

Two TECs (listed under the BC Act) were recorded within the Study Area, **Table C.4** and **Table C.5**, provide test of significance for Cumberland Plain Woodland and River-flat eucalypt forest, respectively.

C.1.1 Microbat Species

Table C-1 Test of Significance: Microbat Species

Threatened Species Assessed: Mammals	
	This five-part test assesses the following mammal species: ▪ Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) ▪ Southern Myotis (*Myotis macropus*) ▪ Greater Broad-nosed Bat (*Scoteanax rueppellii*) Habitat for three insectivorous microbats is present within the Study Area, particularly in PCT 835, PCT 849, patches of trees, paddock trees and in planted native vegetation. These flying mammals are highly mobile and have foraging ranges of tens of kilometres. Roosting habitat for microbat species occurs in tree hollows and decorticating bark, whereas forging resources for these insectivorous species occurs in vegetated areas and canopy of trees. The Southern Myotis also hunts on surface of water bodies, such as Werrington Creek. Potential roosting habitat for Southern Myotis occurs under the road bridge above South Creek-Werrington Creek located near the intersection of Dunheved Road – Christie Road – Werrington Road.
Five-part Test	
a)	*in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*
	The threatened bat species assessed have moderate likelihood of occurrence in vegetation within the Study Area. The Dunheved Road Upgrade project, would require clearing of up to 5.15 ha of native vegetation and trees. Given the amount of potential foraging habitat to be lost is very small compared to available resources elsewhere in the broader locality, including remnant vegetation along Werrington Creek and South Creek. The riparian habitat at South Creek and Werrington Creek and within the Study Area provides limited seasonal foraging grounds for the Southern Myotis because the canopy cover is high and the water levels under the bridge appear to be low outside heavy rainy events. The road bridge over South Creek – Werrington Creek has the potential to be occupied by Southern Myotis for roosting and breeding site. Targeted surveys were outside the scope of works of the present BAR and the possibility of Southern Myotis occupying the road bridge as a roost or breeding habitat is unknown. Based on the information available to date, it is considered that it is unlikely the proposed road upgrade would result in adverse effect on the life cycle of the Eastern Coastal Free-tailed Bat and the Greater Broad-nosed Bat, nor would a local population of these species be placed at risk of extinction. It is uncertain if Southern Myotis roost and/or breeds in the road bridge, therefore, the possibility exists for the proposed road upgrade would have an adverse effect on the life cycle of Southern Myotis.
b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
	Not applicable
	(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
	Not applicable
c)	*In relation to the habitat of a threatened species or ecological community:*

Threatened Species Assessed: Mammals	
	(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
	Up to 3.96 ha of native vegetation and up to 1.19 ha of canopy trees are proposed to be removed, these trees represent limited foraging resources for bat species (e.g. insects over canopy for microbats), compared to larger potential foraging resources likely to occur within Werrington Creek riparian corridor and other vegetated areas within the locality. Trees proposed for removal and containing tree hollows are potential roosting habitat for microbat species. These trees are only a minimal amount of potential roosting habitat for microbats within the Study Area and wider locality. Therefore, the amount of vegetation and trees (including planted trees) requiring removal represent a very small amount of potential habitat for bat species compared to available habitat present elsewhere within the Study Area and wider locality. The road bridge over South Creek – Werrington Creek will not be removed. However, additional bridge lanes will be added to the existing bridge and temporary disturbance to microbat species occupying the bridge are likely to occur.
	(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
	The planted trees, native regrowth, paddock trees and native vegetation to be removed are located in a historically cleared area. Loss of small extent of native vegetation (3.96 ha, including 1.34 ha PCT 849 and 0.22 ha of PCT 835) would result in reduction in the size of existing patches of vegetation. However, these patches are already isolated fragments located in a highly developed landscape. Their removal will not result in habitat for the threatened bat species being fragmented or isolated. Furthermore, new planted trees and landscaped areas are proposed as part of the proposed road upgrade. Planted trees along Dunheved Road would provide stepping stone habitat for bats by reducing gaps between vegetated areas on Werrington Creek – South Creek riparian corridor and other vegetated areas in the immediate locality.
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
	The native vegetation, planted trees and patches of trees/paddock trees proposed to be removed do not represent critical feeding or roosting habitat resources for the threatened bat species assessed herein. Larger amount of foraging habitat occurs in the broader locality, therefore, the vegetation and trees to be cleared are not important habitat for the long-term survival of the threatened bat species.
d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.
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.*
	The proposed development has the potential to trigger the following key threatening processes (KTPs): ▪ Clearing of native vegetation ▪ Human-caused Climate Change ▪ Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands ▪ Infection of frogs by amphibian chytrid causing the disease chytridiomycosis ▪ Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. As detailed in **Section 5**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.
Conclusion	
	The Dunheved Road upgrade footprint occurs mainly in historically cleared land, and up to 5.15 ha of native vegetation, planted trees and native trees, will require clearing. The amount of vegetation to be cleared represents potential foraging habitat for microbat species, however, the vegetation is not considered to represent critical habitat for the long-term survival of the Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). Proposed works within part of the Dunheved Road Upgrade, require removal of up to 5.15 ha of native vegetation. The loss of this small amount of native vegetation is considered acceptable and represent a negligible amount of potential foraging habitat for microbats when compared to available potential resources in the wider locality. Therefore, the proposed Dunheved Road upgrade development would not result in significant

Threatened Species Assessed: Mammals
impacts on foraging habitat for the Eastern Coastal Free-tailed Bat, the Greater Broad-nosed Bat or Southern Myotis. of these threatened bat species. The road bridge over South Creek – Werrington Creek is potential habitat for the Southern Myotis. Targeted surveys for Southern Myotis were outside of the Scope of Works for the present assessment. Based on limited fauna habitat surveys undertaken to date, it is uncertain if Southern Myotis roost and/or breeds in the road bridge, therefore, the possibility exists for the proposed road upgrade would have an adverse effect on the life cycle of Southern Myotis. Further habitat assessment at the road bridge and targeted surveys for the Southern Myotis are warranted to inform assessment of significant risk on this microbat species. Given the uncertainty of impacts on Southern Myotis and potential significant impacts on threatened biodiversity by the Dunheved Road Upgrade, the development proponent has opt into the BOS and preparation of a BDAR is underway. Additional surveys for Southern Myotis have been scheduled as part of the field surveys required to inform the BDAR.

C.1.2 Woodland Birds

Table C-2 Test of Significance: Woodland Birds

Threatened Species Assessed: Woodland Birds	
This five-part test assesses the following bird species: ▪ Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) ▪ Regent Honeyeater (*Anthochaera phrygia*) ▪ Speckled Warbler (*Chthonicola sagittata*) ▪ Diamond Firetail (*Stagonopleura guttata*) ▪ Swift Parrot (*Lathamus discolor*) ▪ Little Lorikeet (*Glossopsitta pusilla*) Habitat for woodland birds is present within the Study Area, particularly in PCT 835, PCT 849, patches of trees, paddock trees and in planted native vegetation. These bird species are highly mobile and have large foraging ranges. Foraging resources for these bird species occur in vegetated areas and canopy of trees.	
Five-part Test	
a)	*in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*
The threatened bird species assessed have moderate likelihood of occurrence in vegetation within the Study Area. The Dunheved Road Upgrade project, would require clearing of up to 5.15 ha of vegetation and trees. Given the amount of potential foraging habitat to be lost is very small compared to available resources elsewhere in the broader locality, including remnant vegetation along Werrington Creek and South Creek, it is considered that it is unlikely the proposed road upgrade would result in adverse effect on the life cycle of these bird species, nor would a local population of these species be placed at risk of extinction.	
b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable	
	(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
Not applicable	
c)	*In relation to the habitat of a threatened species or ecological community:*
	(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
Up to 5.15 ha of vegetation and trees are proposed to be removed, these trees represent limited foraging resources for fauna species, including bird species, compared to larger potential foraging resources likely to occur within Werrington Creek riparian corridor and other vegetated areas within the locality. Trees to be	

Threatened Species Assessed: Woodland Birds	
	removed provide roosting and refuge for bird species. More trees are present in remnant vegetation in the wider locality. Therefore, the amount of vegetation and trees (including planted trees) requiring removal represent a very small amount of potential habitat for birds, including threatened birds, compared to available habitat present elsewhere within the Study Area and wider locality.
	(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
	The planted trees, native regrowth, paddock trees and native vegetation to be removed are located in a historically cleared area. Loss of small extent of native vegetation (5.15 ha, including 3.96 ha of native vegetation and 1.19 ha of canopy) would result in reduction in the size of existing patches of vegetation. However, these patches are already isolated fragments located in a highly developed landscape. Their removal will not result in habitat for the threatened bird species being fragmented or isolated. Furthermore, new planted trees and landscaped areas are proposed as part of the proposed road upgrade. Planted trees along Dunheved Road would provide stepping stone habitat for bats by reducing gaps between vegetated areas on Werrington Creek – South Creek riparian corridor and other vegetated areas in the immediate locality.
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
	The native vegetation, planted trees and patches of trees/paddock trees proposed to be removed do not represent critical feeding or roosting habitat resources for the threatened birds assessed herein. Larger amount of foraging habitat occurs in the broader locality, therefore, the vegetation and trees to be cleared are not important habitat for the long-term survival of the threatened bird species.
d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.
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.*
	The proposed development has the potential to trigger the following key threatening processes (KTPs): ▪ Clearing of native vegetation ▪ Human-caused Climate Change ▪ Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands ▪ Infection of frogs by amphibian chytrid causing the disease chytridiomycosis ▪ Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. As detailed in **Section 5**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.
Conclusion	
	The Dunheved Road upgrade footprint occurs mainly in historically cleared land, up to 5.15 ha of native vegetation, planted trees and native trees, will require clearing. The amount of vegetation to be cleared represents potential foraging and roosting habitat for bird species, however, the vegetation is not considered to represent critical habitat for the long-term survival of the Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), Regent Honeyeater (*Anthochaera phrygia*), Speckled Warbler (*Chthonicola sagittata*), Diamond Firetail (*Stagonopleura guttata*), Swift Parrot (*Lathamus discolor*), Little Lorikeet (*Glossopsitta pusilla*) or other birds (e.g. migratory birds). Proposed works part of the Dunheved Road Upgrade, require removal of up to 3.96 ha of native vegetation (PCT849, PCT835, planted natives and native regrowth with exotics) and 1.19 ha of canopy (remnant and paddock trees, including 0.72ha of PCT849_Remnant trees). The loss of this small amount of native vegetation is represents negligible loss of potential foraging habitat for birds when compared to available potential resources in the wider locality. Therefore, the proposed Dunheved Road upgrade development would not result in significant impacts on habitat of these threatened bird species.

C.1.3 Cumberland Plain Land Snail

Table C-3 Test of Significance: Cumberland Plain Land Snail

Threatened Species Assessed: Cumberland Plain Land Snail	
	This five-part test assesses the following land snail species: ▪ Cumberland Plain Land Snail (*Meridolum corneovirens*) Habitat for the Cumberland Plain Land Snail (CPLS) is present in patches of PCT 849 and PCT 835 within the Study Area and up to 1.56 ha of potential CPLS habitat will require clearing as part of the proposed Dunheved Road Upgrade. Due to the high level of historical disturbance in cleared areas, planted natives, patches of trees and paddock trees, it is considered unlikely the CPLS would occur therein. The CPLS lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. It can dig several centimetres into soil to escape drought. It is generally active at night and is a fungus specialist. The CPLS has very small home ranges, as small as only 300 m (Dr Stephanie Clark *per com*). Determination of presence of this small cryptic species requires detailed targeted survey after rain events, when it is though individuals are more active. One shell and a fragment of a shell of CPLS were recorded in February 2022 and within a patch of PCT849 within the Study Area.
Five-part Test	
a)	*in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*
	The threatened CPLS species assessed have moderate likelihood of occurrence in PCT 849 and PCT 835 within the Study Area. The Dunheved Road Upgrade project, would require clearing of up to 1.56 ha of potential CPLS habitat (0.22 ha of PCT 835 and up to 1.34 ha of PCT 849). Given that the CPLS has very small habitat range, loss of individuals of a local population is considered to have potentially significant effects on a local population of the species, including placing a local population of CPLS at risk of extinction. Avoidance and mitigation measures are recommended to prevent net loss of individuals of the CPLS and to avoid long-term effects on a local population of the CPLS. Avoidance of loss of individuals would be managed by preparing and implementing a pre-clearance and clearance protocol prior to clearing to minimise the potential loss of individuals of the CPLS. A CPLS management plan for selecting an agreed translocation area/site would ensure long-term viability of a local population of the species.
b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
	Not applicable
	(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
	Not applicable
c)	*In relation to the habitat of a threatened species or ecological community:*
	(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
	Up to 1.56 ha of suitable habitat for the CPLS is proposed to be removed, and over 1.77 ha of Cumberland Plain Woodland adjacent to the Study Area will remain. Therefore, the amount of suitable habitat for the CPLS requiring removal represent approximately 47% of potential habitat for the species in the Study Area and the immediate locality.
	(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
	The native vegetation (PCT 849 and PCT 835) to be removed are located in a highly developed landscape with evidence of disturbance, waste dumping and weed invasion. Loss of small extent of CPLS habitat in native vegetation (1.34 ha PCT 849 and 0.22 ha of PCT 835) would result in reduction in the size of existing patches of vegetation. However, these patches are already isolated fragments located in a highly developed landscape. Their removal will further contribute to further reduction in the extent of existing patches of potential habitat for the CPLS, but the contribution to further isolate or fragment the patches will be negligible. Furthermore, new planted trees and landscaped areas are proposed as part of the proposed road upgrade. Selection of native trees and species as planting might contribute to enhance fungal population in soil and indirectly favour long-

Threatened Species Assessed: Cumberland Plain Land Snail	
	term food resources for the species across the landscape, such as along the Werrington Creek – South Creek riparian corridor.
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
	The habitat of the CPLS to be removed is commensurate with threatened ecological communities (TECs) (i.e. Cumberland Plain Woodland and River-flat eucalypt forests), these TECs are the primary habitat for the CPLS. Therefore, the extent of PCT 849 and PCT 835 to be loss, as small as it seems, is very important for the long-term survival of a local population of the CPLS. Shells of the CPLS were only found in a patch of PCT 849 and in leaf litter located within the edge of the patch of vegetation adjacent to Dunheved Road, the area requiring clearing to give way to the road widening. The vegetation in this area was mapped as being in low condition due to the presence of weeds, evidence of disturbance and waste dumping. It is noted that the eastern portion of the patch, further away from the road, will be retained and it will be considered for translocation of any individuals found during pre-clearing. This will ensure that no individuals are impacted/killed during construction phase of the project and more importantly, will minimise as far as practicable any impacts on local individuals of the CPLS and in the long-term survival of a local population.
d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.
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.*
	The proposed development has the potential to trigger the following key threatening processes (KTPs): ▪ Clearing of native vegetation ▪ Human-caused Climate Change ▪ Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands ▪ Infection of frogs by amphibian chytrid causing the disease chytridiomycosis ▪ Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. As detailed in **Section 4**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.
Conclusion	
	The Dunheved Road upgrade footprint occurs mainly in historically cleared land, but up to 1.34 ha of PCT 849 and up to 0.22 ha of PCT 835 will require clearing. These PCTs are commensurate with TECs (i.e. Cumberland Plain Woodland and River-flat eucalypt forest, respectively), which is important vegetation and represents primary habitat for the Cumberland Plain Land Snail (*Meridolum corneovirens*). The Cumberland Plain Land Snail (CPLS) has very small habitat range, and loss of one or few individuals of a local population have the potential to result in significant effects on the long-term survival of a local population of the species. Therefore, it is recommended to avoid impacts on PCTs 849 and 835, and where residual impacts are not practical, it is recommended to prepare and implement a pre-clearance and clearance protocol to avoid loss of individuals of the CPLS. The protocol must also identify and agree on a suitable translocation site known to be occupied by the CPLS. Where individuals of the species are found, it is recommended to translocate them to the agreed translocation site as a measure to avoid impact on a local population of the species. Given the potential significant impacts on CPLS, the development proponent has opt into the BOS and preparation of a BDAR is underway. Additional surveys for CPLS and identification of a suitable translocation site within the Study Area have been scheduled as part of the field surveys required to inform the BDAR.

C.1.4 Cumberland Plain Woodland

Table C-4 Test of Significance: Cumberland Plain Woodland

Threatened Species Assessed: Cumberland Plain Woodland
This five-part test assesses the following TEC: ▪ Cumberland Plain Woodland: – BC Act Name: Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)

Threatened Species Assessed: Cumberland Plain Woodland	
	PCT 849 in low, moderate and low-moderate condition within the Study Area were commensurate with the BC Act listed Cumberland Plain Woodland (CPW). For purposes of the present test of significance (ToS), remnant trees of species part of the CPW are considered part of the BC Act listed CEEC. The Cumberland Plain Woodland was recorded in: ▪ Patches adjacent to the southern boundary of the Dunheved Gold Club and east to residential properties at the eastern end of Lockyer Avenue. ▪ A long area of Cumberland Plain Woodland is present in land adjacent to the western bound of Dunheved Road between Francis Street and Wrench Street. ▪ A patch on an open area at 115 Dunheved Road, located between Brookfield Avenue and Valleyview Crescent, on the eastern bound of Dunheved Road. ▪ Remnant trees were recorded along Dunheved Road as shown in ground-truthed vegetation map (**Figure 3-1** to **Figure 3-5**). The patches of Cumberland Plain Woodland have a weedy component, which was observed to be more prominent on edges adjacent to the road and cleared land.
Five-part Test	
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*
	Not applicable
b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
	Up to 1.34 ha of Cumberland Plain Woodland (CPW), i.e. PCT 849, is proposed to be removed as part of the Dunheved Road Upgrade project. Over 1.77 ha of CPW located immediately adjacent to the Study Area will remain. The portion of CPW to be cleared is the part of the patch of vegetation closer to the existing Dunheved Road and was mapped as being in low condition due to the presence of weeds and level of disturbance. Therefore, it is considered that the extent of CPW to be cleared is small compared to area of the TEC to be retained and the proposed clearing is unlikely to place the Cumberland Plain Woodland at risk of extinction. It is noted, however, that the CPW proposed for clearing will further contribute to reduction in extent of the TEC in the state of NSW. In order to avoid net-loss and mitigate the impact, offsets as per the BOS will need to be complied with.
	(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.
	The portion of the CPW to be cleared is located nearest to the road and cleared land (i.e. edges), these edges have higher weedy component than areas of a patch further away from edges. Therefore, removal of the weedier section of patches of the TEC will contribute to modification of the current community by removing the weediest portion and preventing further weed seedbank due to weed removal. On the other hand, the removal of current border of a patch will result in the creation of new edge, which could indirectly facilitate incursion of weeds (such as weeds dispersed on roads) to establish in 'healthier' portions of the TEC. It is acknowledged, that incursion of weeds into the TEC is a process currently occurring in the patches of TECs due to their location adjacent to roads, exotic grassland/herbfields and residential properties (with garden escapees and garden waste dumped). Therefore, the level of weed incursion into new edges would continue at the same rate as it is currently occurring. Based on this, it is considered that the project is likely to result in facilitating weed invasion into inner parts of the TEC. Albeit, not resulting in substantially and adversely modifying the composition of the TEC. As part of mitigation measures, it is proposed to create a 'soft fence' along the newly created edges. The 'soft fence' will consist of planting of turf species characteristic of the TEC (e.g. turf grasses, lomandras and lilies) to create a barrier between the road/footpath and the TEC. This would assist in reducing the rate of roadside weed invasion into the TEC.
c)	*In relation to the habitat of a threatened species or ecological community:*
	(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
	Up to 1.34 ha of the CPW is proposed to be removed, this represents approximately 23% of the vegetation community in the immediate locality. Therefore, the extent of CPW habitat requiring removal represent a very small amount of the current patch extent in the Study Area and broader locality.

Threatened Species Assessed: Cumberland Plain Woodland

(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

The patches of CPW whose extent will be reduced by clearing are located in a highly developed landscape. Loss of small extent of those patches of the TEC would result in reduction in the size of existing patches of vegetation. However, these patches are already isolated fragments located in a highly developed landscape. Their removal will further contribute to further reduction in the extent of existing patches of CPW, but the contribution to further isolate or fragment the patches will be negligible. Furthermore, new planted trees and landscaped areas are proposed as part of the proposed road upgrade.

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

The portion of patches of CPW to be removed are the portions of patches with the highest level of weed cover. Removal of the weediest part of a patch will assist in preventing weed cover advancing further into the inner parts of a patch, resulting in preventing further deterioration (e.g. reduction in vegetation condition). The patches of the TEC are already present as isolated patches in a highly developed residential/industrial landscape. Therefore, clearing of the outer edge of a patch will result in reducing the extent of the patch but not its fragmentation or isolation as these are surrounded by developed areas (e.g. road, residential property, cleared land). Therefore, the extent of CPW will be reduced by approximately 43%, but the loss of extent *per se* will not result in adversely affecting the long-term survival of the impacted patches of Cumberland Plain Woodland. Management of the remaining patch of CPW will be required to manage edge effects and avoid/minimise incursion of exotic plants into the retained CPW.

At a large spatial scale, however, it is considered that loss of CPW, regardless of its extent, further contributes to place the long-term survival of the Cumberland Plain Woodland CEEC at risk of extinction. Therefore, any impact on CPW must be mitigated to avoid net-loss of this TEC. Vegetation of the Cumberland Plain and CPW therein has been estimated as follows:

- NPWS (2002): Estimated that only 28.4% of the modelled pre-1750 vegetation remained in the Cumberland Plain, the extant vegetation including patches of native vegetation (codes A, B, C and SA in their mapping, representing 13.4% (35,949.7ha)) and scattered trees (codes Cmi, TX, TXR, TXU in their mapping, representing 15.05% (40,458.6 ha)). The extent of Cumberland Plain Woodland was estimated to be:
  - Native Vegetation: A total of 11,054.5 ha of Cumberland Plain Woodland (CPW) was estimated to occur within the Cumberland Plain, representing 30.75% of the extant native vegetation. Only 1,906.2 ha (5.3%) of CPW occurred within Penrith LGA.
  - Scattered Trees: A total of 17,120.5 ha of scattered trees part of CPW were estimated to occur within the Cumberland Plain, of which only 2,555.6 ha (i.e. 14.93 %) were estimated to occur within Penrith LGA.

  This indicates that the area (ha) of extant of CPW as scattered trees was larger than the area occupied by native vegetation (e.g. bushland).
- DECCW (2010) *Cumberland Plain Recovery Plan. Approved Recovery Plan*. DECCW (2010), estimated that only 13% of the pre-1750 extent of native vegetation remains in intact bushland, with additional 12% occurring as scattered trees in disturbed areas. DECCW (2010), estimated that the total extent of the BC Act listed CPW in the Cumberland Plain was 10,612 ha, of which only 4,171 ha (39 %) were estimated to be in Priority Conservation Lands. This suggests that 61% (6,441 ha) of the BC Act listed CPW would occur in smaller patches, in private land and non-reserved land.
- DPIE (2020b) *Sub-plan A: Conservation and Implementation. Draft Cumberland Plain Conservation Plan*: DPIE (2020b) indicates that as part of development of Western Sydney, native vegetation, including TECs will be impacted by the proposed urban development and proposed infrastructure corridors. This will include impacts on eight BC Act listed TECs and five EPBC Act listed TECs. Cumberland Plain Woodland is among the most impacted TECs, including 1,014.6 ha of CPW part of PCT849 and PCT850. Land within Penrith LGA is part of the proposed Western Sydney development, however, the area of impact on CPW within Penrith LGA is unknown. The impact on CPW (DPIE 2020b) represents loss of 9.18% of the extent of CPW within the Cumberland Plain estimated by NPWS (2002).

It is unknown how many hectares of CPW had been lost over the last 20 years since NPWS (2002) extant estimation. This is the case because a centralised dataset recording the cumulative loss of CPW, or any other TEC or PCT, due to approved development at the local or state level does not exist. Based on DECCW (2010) estimation a total of 442.5 ha (4.0%) of CPW was lost in the Cumberland Plain between 2002 and 2010. The development of Western Sydney (DPIE 2020b) would add at least 1,014.6ha of CPW loss. It is predicted however, that the loss of native vegetation across the Cumberland Plain and Penrith LGA would have been much larger over the last 20 years, including the real cumulative loss of CPW. Therefore, it is considered that any net-loss on the extent of CPW is most likely significant as the long-term presence of the TEC is further placed at risk of extinction due to clearing and development.

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)

Threatened Species Assessed: Cumberland Plain Woodland
The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.
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.
The proposed development has the potential to trigger the following key threatening processes (KTPs): ▪ Clearing of native vegetation ▪ Human-caused Climate Change ▪ Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands ▪ Infection of frogs by amphibian chytrid causing the disease chytridiomycosis ▪ Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. As detailed in **Section 5**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.
Conclusion
The Dunheved Road upgrade footprint occurs mainly in historically cleared land, where isolated patches of Cumberland Plain Woodland (CPW) occur. Up to 1.34 ha of CPW patches will require clearing and this represents 43% of the existing CPW in the Study Area and immediate land. An area of approximately 1.77 ha of CPW will remain in land adjacent to the Construction Boundary. Active management of the remaining 1.77 ha of CPW will be required to secure the long-term survival of the CEEC in land adjacent to the Construction Boundary. In 2002, NPWS (2002) estimated that only 28.40 % of pre-1750 native vegetation remained across the Cumberland Plain, including 13.4% as bushland and 15.05 % as scattered trees. At that time, CPW represented only 30.74% of the remaining bushland and 42.32% of scattered trees. In 2009, the NSW TSSC recognised that the loss of CPW had increased and changed the threatened listing of this TEC from Endangered to Critically Endangered. It is unknown what has been the total clearing of CPW in the last 20 years, since publication of vegetation mapping in the Cumberland Plain (NPWS 2002) and the change of threatening listing status of the CPW, because there is not centralised database where the cumulative loss of native vegetation at a local, state or national level is recorded. It is considered, however, that any loss of CPW will further place this TEC at risk of extinction. Therefore, it is considered that the loss of 1.34 ha of CPW due to the proposed Dunheved Road Upgrade will further contribute to loss of extent of this TEC and that this loss is most likely a significant impact as the long-term presence of the CPW is further placed at risk of extinction due to clearing and development.

C.1.5 River-flat Eucalypt Forest

Table C-5 Test of Significance: River-flat Eucalypt Forest

Threatened Species Assessed: River-flat Eucalypt Forest
This five-part test assesses the following TEC: ▪ River-flat Eucalypt Forest: – BC Act Name: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC) PCT 835 in low-moderate and very-low condition within the Study Area were commensurate with the TEC known as River-flat Eucalypt Forest. The River-flat Eucalypt Forest was recorded in: ▪ Patches on Werrington Creek riparian corridor. ▪ A patch approximately 100m west of Werrington Creek where a creek line is mapped (but not observed during site inspection). The patches of River-flat Eucalypt Forest were disturbed with a high component of weeds.
Five-part Test
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
Not applicable

Threatened Species Assessed: River-flat Eucalypt Forest	
b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
	Up to 0.22 ha of River-flat Eucalyptus Forest (RFEF), i.e PCT 835, are proposed to be removed as part of the Dunheved Road Upgrade project. This represents a small fraction of a much larger area of the vegetation present in the wider locality. Therefore, it is considered that the extent of RFEF to be cleared is small compared to area of the TEC to be retained and the proposed clearing is unlikely to place the River-flat Eucalypt Forest at risk of extinction. It is noted, however, that the condition of the RFEC is quite degraded and in its current condition and unmanaged status, it is likely the remaining native species will be replaced by exotic weeds in the near future.
	(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.
	The portion of the RFEF present within the Study Area is highly disturbed and is weed dominated. Removal of a portion of these degraded patches of the TEC, is unlikely to result in the RFEF being at risk of extinction.
c)	*In relation to the habitat of a threatened species or ecological community:*
	(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
	Up to 0.22 ha of the RFEF is proposed to be removed to give way to the project. Therefore, the extent of RFEF habitat requiring removal represent a very small amount of the current patch extent in the Study Area and broader locality.
	(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
	The patches of RFEC whose extent will be reduced by clearing are part of a continuous and larger bushland extending beyond the Study Area into the Dunheved Golf Club and along Werrington Creek – South Creek riparian corridor. The extent of existing patches of bushland will be minimally reduced, but no fragments will be created as result of works required for the proposed road upgrade.
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
	The portion of patches of RFEF to be removed are the portions of considerably larger areas of bushland within the Werrington Creek – South Creek riparian corridor. The portion of RFEF to be removed is in disturbed condition and weed dominated, therefore, this area is no longer important or critical area of the TEC. Therefore, the loss of 0.22 ha of RFEF will likely represent a small portion of the extent of a TEC, and a negligible portion of the extent of bushland, likely part of the TEC, present in the wider locality. The removal of highly disturbed portion of the RFEF, is unlikely to result in impacts on the long-term survival of the TEC in the locality.
d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.
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.*
	The proposed development has the potential to trigger the following key threatening processes (KTPs): ▪ Clearing of native vegetation ▪ Human-caused Climate Change ▪ Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands ▪ Infection of frogs by amphibian chytrid causing the disease chytridiomycosis ▪ Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. As detailed in **Section 5**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.
Conclusion	

Threatened Species Assessed: River-flat Eucalypt Forest
The Dunheved Road upgrade footprint occurs mainly in historically cleared land, where remnant bushland occurs as part of Werrington Creek – South Creek riparian corridor. The area of River-flat Eucalypt Forest (RFEF) to be cleared to give way to the proposed development footprint represents a very small part of RFEF in the Study Area and wider locality. Furthermore, the areas of RFEC within the Study Area to be cleared are highly disturbed and weed dominated areas. As part of the project's mitigation approach, offsets as per the BOS under the BC Act will be obtained to compensate the loss of extent of RFEF. If offsetting includes 1:1 replacement this would result in no net loss of RFEF due to the proposed Dunheved Road Upgrade project. It is considered that provided impacts on RFEF are limited to areas with weed dominated areas in very low condition of the TEC and offset obligations are meet, the proposed project will not result in significant impacts on River-flat Eucalypt Forest.

C.3 Assessment of Significance (EPBC Act)

Two TECs (listed under the EPBC Act) were recorded within the Study Area, **Table C.6** and **Table C.7**, provide test of significance for Cumberland Plain Woodland and River-flat eucalypt forest, respectively.

C.3.1 Cumberland Plain Woodland

Table C-6 Assessment of Significance: Cumberland Plain Woodland

TEC Assessed: Cumberland Plain Woodland
This AoS assesses the following TEC: ▪ Cumberland Plain Woodland: – EPBC Act name: Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CEEC) PCT 849 in low, moderate and low-moderate condition within the Study Area were commensurate with the EPBC Act listed Cumberland Plain Woodland (CPW). For purposes of the present test of significance (ToS), remnant trees of species part of the CPW are not considered part of the EPBC Act listed CEEC. The Cumberland Plain Woodland was recorded in: ▪ Patches adjacent to the southern boundary of the Dunheved Gold Club and east to residential properties at the eastern end of Lockyer Avenue. ▪ A long area of Cumberland Plain Woodland is present in land adjacent to the western bound of Dunheved Road between Francis Street and Wrench Street. ▪ A patch on an open area at 115 Dunheved Road, located between Brookfield Avenue and Valleyview Crescent, on the eastern bound of Dunheved Road. ▪ Remnant trees were recorded along Dunheved Road as shown in ground-truthed vegetation map (**Figure 3-1** to **Figure 3-5**). The patches of Cumberland Plain Woodland have a weedy component, which was observed to be more prominent on edges adjacent to the road and cleared land.
AoS
a) Reduce the extent of an ecological community
Up to 0.62 ha of Cumberland Plain Woodland (CPW), i.e. PCT 849, is proposed to be removed as part of the Dunheved Road Upgrade project over 1.77 ha of CPW located immediately adjacent to the Study Area will remain. The portion of CPW to be cleared is the part of the patch of vegetation closer to the existing Dunheved Road and was mapped as being in low condition due to the presence of weeds and level of disturbance. Therefore, it is considered that the extent of CPW to be cleared is small compared to area of the TEC to be retained. Management of the remaining patches of CPW will be required to manage edge effects and avoid/minimise incursion of exotic plants into the retained CPW (see below). With suitable management, the proposed clearing is unlikely to place the remaining local patches of Cumberland Plain Woodland at risk of extinction. At a broader spatial scale, however, it is considered that loss of CPW, regardless of its extent, contributes to cumulative impacts that could result in the long-term survival of the Cumberland Plain Woodland CEEC. Therefore, any impact on CPW must be mitigated to avoid net-loss of this TEC. Vegetation of the Cumberland Plain and CPW therein has been estimated as follows: ▪ NPWS (2002): Estimated that only 28.4% of the modelled pre-1750 vegetation remained in the Cumberland Plain, the extant vegetation including patches of native vegetation (codes A, B, C and SA in their mapping,

TEC Assessed: Cumberland Plain Woodland

representing 13.4% (35,949.7ha)) and scattered trees (codes Cmi, TX, TXR, TXU in their mapping, representing 15.05% (40,458.6 ha)). The extent of Cumberland Plain Woodland was estimated to be:

- Native Vegetation: A total of 11,054.5 ha of Cumberland Plain Woodland (CPW) was estimated to occur within the Cumberland Plain, representing 30.75% of the extant native vegetation. Only 1,906.2 ha (5.3%) of CPW occurred within Penrith LGA.
- Scattered Trees: A total of 17,120.5 ha of scattered trees part of CPW were estimated to occur within the Cumberland Plain, of which only 2,555.6 ha (i.e. 14.93 %) were estimated to occur within Penrith LGA.

This indicates that the area (ha) of extant of CPW as scattered trees was larger than the area occupied by native vegetation (e.g. bushland).

- DECCW (2010) *Cumberland Plain Recovery Plan. Approved Recovery Plan*. DECCW (2010), estimated that only 13% of the pre-1750 extent of native vegetation remains in intact bushland, with additional 12% occurring as scattered trees in disturbed areas. DECCW (2010), estimated that the total extent of the BC Act listed CPW in the Cumberland Plain was 10,612 ha, of which only 4,171 ha (39 %) were estimated to be in Priority Conservation Lands. This suggests that 61% (6,441 ha) of the BC Act listed CPW would occur in smaller patches, in private land and non-reserved land.
- DPIE (2020b) *Sub-plan A: Conservation and Implementation. Draft Cumberland Plain Conservation Plan*: DPIE (2020b) indicates that as part of development of Western Sydney, native vegetation, including TECs will be impacted by the proposed urban development and proposed infrastructure corridors. This will include impacts on eight BC Act listed TECs and five EPBC Act listed TECs. Cumberland Plain Woodland is among the most impacted TECs, including 1,014.6 ha of CPW part of PCT849 and PCT850. Land within Penrith LGA is part of the proposed Western Sydney development, however, the area of impact on CPW within Penrith LGA is unknown. The impact on CPW (DPIE 2020b) represents loss of 9.18% of the extent of CPW within the Cumberland Plain estimated by NPWS (2002).

It is unknown how many hectares of CPW had been lost over the last 20 years since NPWS (2002) extant estimation. This is the case because a centralised dataset recording the cumulative loss of CPW, or any other TEC or PCT, due to approved development at the local or state level does not exist. Based on DECCW (2010) estimation a total of 442.5 ha (4.0%) of CPW was lost in the Cumberland Plain between 2002 and 2010. The development of Western Sydney (DPIE 2020b) would add at least 1,014.6 ha of CPW loss. It is predicted however, that the loss of native vegetation across the Cumberland Plain and Penrith LGA would have been much larger over the last 20 years, including the real cumulative loss of CPW. Therefore, it is considered that any net-loss on the extent of CPW is most likely significant as the long-term presence of the TEC is further placed at risk of extinction due to cumulative clearing and development.

b) Fragment or increase fragmentation of an ecological community

The patches of CPW whose extent will be reduced by clearing are located in a highly developed landscape. Loss of small extent of those patches of the TEC would result in reduction in the size of existing patches of vegetation. However, these patches are already isolated fragments located in a highly developed landscape. Their removal will further contribute to further reduction in the extent of existing patches of CPW, but the contribution to further isolate or fragment the patches will be negligible. Furthermore, new planted trees and landscaped areas are proposed as part of the proposed road upgrade.

c) Adversely affect habitat critical to the survival of an ecological community

The proposed impacts would be predominately isolated to the disturbed fringing areas of the Study Area. Notwithstanding that CPW in these areas is not in good condition, some areas of current occupancy would be permanently lost. These areas are however not critical to the survival of the TEC in and adjacent to the study area or more broadly.

d) Modify or destroy abiotic factors necessary for an ecological community's survival

In addition to vegetation removal some areas would be replaced by hard stand. However, this would not change abiotic conditions in retained areas.

e) Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:

(i) Assisting invasive species, that are harmful to the ecological community, to become established, or

(ii) Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

The portion of the CPW to be cleared is located nearest to the road and cleared land (i.e. edges), these edges have higher weedy component than areas of a patch further away from edges. Therefore, removal of the weedier section of patches of the TEC will contribute to modification of the current community by removing the weediest portion and preventing further weed seedbank due to weed removal. On the other hand, the removal of current border of a patch will result in the creation of new edge, which could indirectly facilitate incursion of weeds (such as weeds dispersed on roads) to establish in 'healthier' portions of the TEC.

TEC Assessed: Cumberland Plain Woodland	
	It is acknowledged, that incursion of weeds into the TEC is a process currently occurring in the patches of TECs due to their location adjacent to roads, exotic grassland/herbfields and residential properties (with garden escapees and garden waste dumped). Therefore, the level of weed incursion into new edges would continue at the same rate as it is currently occurring. Based on this, it is considered that the project is likely to result in facilitating weed invasion into inner parts of the TEC. Albeit, not resulting in substantially and adversely modifying the composition of the TEC. As part of mitigation measures, it is proposed to create a 'soft fence' along the newly created edges. The 'soft fence' will consist of planting of turf species characteristic of the TEC (e.g. turf grasses, lomandras and lilies) to create a barrier between the road/footpath and the TEC. This would assist in reducing the rate of roadside weed invasion or fertilisers, herbicides or other chemicals or pollutants into the TEC.
(f)	*Interfere with the recovery of an ecological community*
	As above, the project would be predominately limited to disturbed area of the TEC within the Study Area and given compensatory replanting of trees at a rate 1:1 is proposed on the new road reserve it is considered unlikely that the project would interfere with the recovery of the ecological community in the locality.
Conclusion	
	The Dunheved Road upgrade footprint occurs mainly in historically cleared land, where isolated patches of Cumberland Plain Woodland (CPW) occurs and up to 0.62 ha of CPW patches will require clearing. Although it is expected that all remaining patches of the TEC within and immediately adjacent to the Study Area would persist, it is considered that given the loss of 0.62 ha of CPW would potentially 'reduce the extent of the community' (see (a) above) and would contribute to cumulative impacts to this CE TEC, this loss could be considered a significant impact. As a precautionary approach it may be appropriate to consider a Referral to the Commonwealth Government.

C.3.2 River-flat Eucalypt Forest

Table C-5 Assessment of Significance: River-flat Eucalypt Forest

TEC Assessed: River-flat Eucalypt Forest	
	This AoS assesses the following TEC: ▪ River-flat Eucalypt Forest: – EPBC Act name: River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC) PCT 835 in low-moderate within the Study Area was commensurate with the TEC known as River-flat Eucalypt Forest. The River-flat Eucalypt Forest was recorded in: ▪ Patches on Werrington Creek riparian corridor. ▪ A patch approximately 100m west of Werrington Creek where a creek line is mapped (but not observed during site inspection). The patches of River-flat Eucalypt Forest were disturbed with a high component of weeds.
AoS	
a)	*Reduce the extent of an ecological community*
	Only 0.01 ha of River-flat Eucalyptus Forest (RFEF), i.e PCT 835, is proposed to be removed as part of the Dunheved Road Upgrade project. The clearance of this very small amount is likely able to be offset by like-for-like replating (i.e. so there would be no net loss) it would not reduce the extent of this TEC.
b)	*Fragment or increase fragmentation of an ecological community*
	The patches of RFEC whose extent will be reduced by clearing are part of a continuous and larger bushland extending beyond the Study Area into the Dunheved Golf Club and along

TEC Assessed: River-flat Eucalypt Forest	
	Werrington Creek – South Creek riparian corridor. The extent of existing patches of bushland will be minimally reduced, but no fragments will be created as result of works required for the proposed road upgrade.
c)	*Adversely affect habitat critical to the survival of an ecological community*
	The portion of patches of RFEF to be removed are the portions of considerably larger areas of bushland within the Werrington Creek – South Creek riparian corridor. The portion of RFEF to be removed is in disturbed condition and weed dominated, therefore, this area is no longer important or critical area of the TEC.
d)	*Modify or destroy abiotic factors necessary for an ecological community's survival*
	In addition to vegetation removal some areas would be replaced by hard stand. However, this would not change abiotic conditions in retained areas.
e)	*Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:*
	(i) Assisting invasive species, that are harmful to the ecological community, to become established, or
	(ii) Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community
	As detailed in **Section 5**, a range of project design, proposed plantings and mitigation measures would avoid these potential impacts occurring. The clearance of this very small amount is likely able to be offset by like-for-like replanting.
(f)	*Interfere with the recovery of an ecological community*
	As above, the project would be predominately limited to disturbed area of the TEC within the Study Area and given compensatory replanting of trees at a rate 1:1 is proposed on the new road reserve it is considered unlikely that the project would interfere with the recovery of the ecological community in the locality.
Conclusion	
	The Dunheved Road upgrade footprint occurs mainly in historically cleared land, where remnant bushland occurs as part of Werrington Creek – South Creek riparian corridor. The area of River-flat Eucalypt Forest (RFEF) to be cleared to give way to the proposed development footprint represents a very small part of RFEF in the Study Area and wider locality. Furthermore, the areas of RFEC within the Study Area to be cleared are highly disturbed and weed dominated areas. As part of the project's mitigation approach, offsets as per the BOS under the BC Act will be obtained to compensate the loss of extent of RFEF. Offset contribution will result in no net loss of RFEF due to the proposed Dunheved Road Upgrade project. Therefore, it is considered that provided impacts on RFEF are limited to areas with weed dominated areas in very low condition of the TEC and with compensatory replanting, the proposed project will not result in significant impacts on River-flat Eucalypt Forest. As such, a Referral to the Commonwealth Government is not considered necessary.

APPENDIX

D

BMAT REPORTS

Cardno

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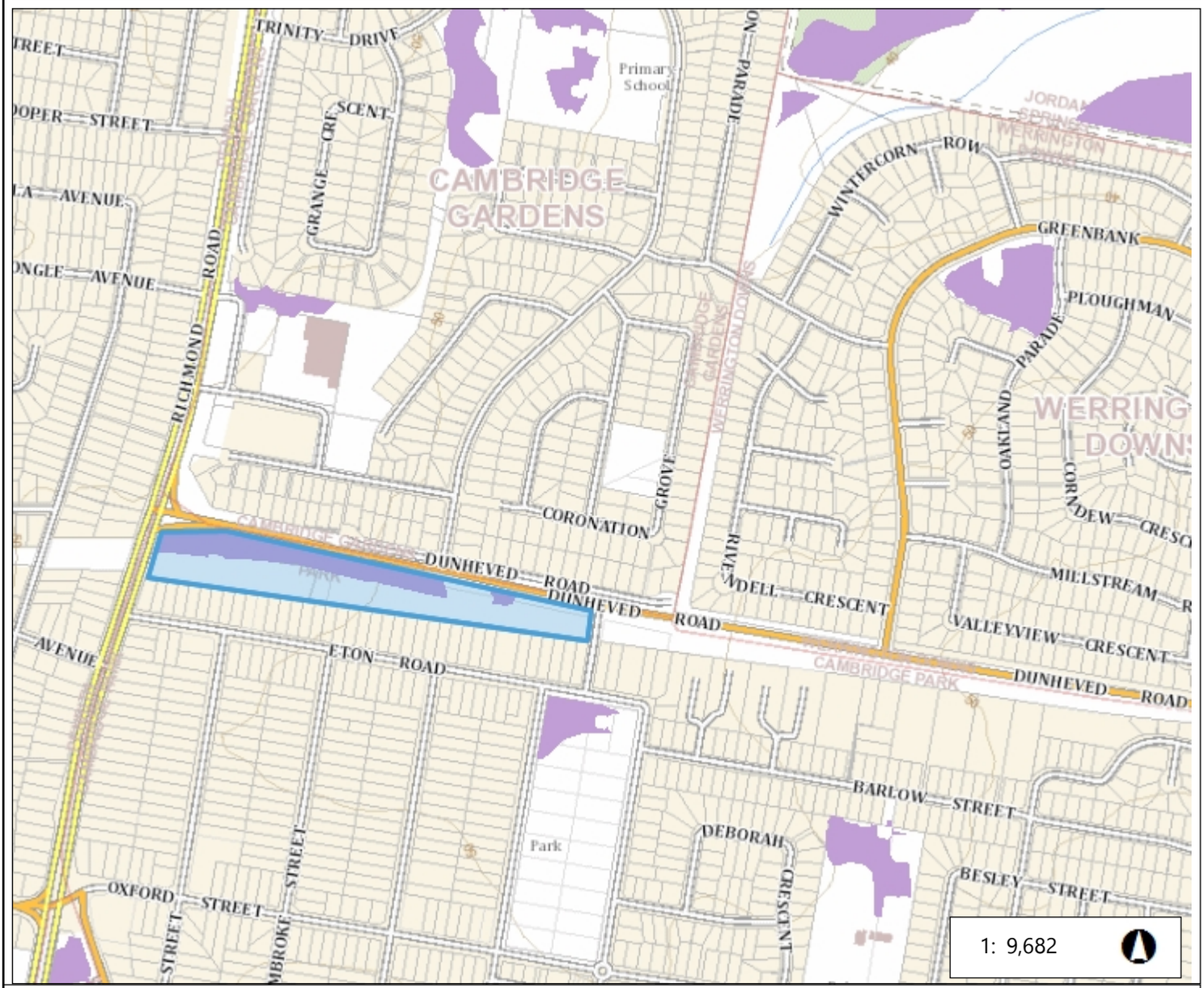
Stantec

Biodiversity Values Map



491.8 0 245.91 491.8 Metres

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Biodiversity Values that have been mapped for more than 90 days
- Biodiversity Values added within last 90 days

Notes

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	13/07/2022 12:55 PM	**BDAR Required***
Total Digitised Area	34,584.2 sqm	
Minimum Lot Size Method	LEP	
Minimum Lot Size 10,000sqm = 1ha	400 sqm	
Area Clearing Threshold 10,000sqm = 1ha	2,500 sqm	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes	yes
Date of the 90 day Expiry	N/A	

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
- 'No': you have not exceeded the BOS threshold. You may still require a permit from local council. Review the development control plan and consult with council. You may still be required to assess whether the development is '"likely to significantly affect threatened species' as determined under the test in s. 7.3 of the Biodiversity Conservation Act 2016. You may still be required to review the area where no vegetation mapping is available.

Where the area of impact occurs on land with no vegetation mapping available, the tool cannot determine the area of native vegetation cleared and if this exceeds the Area Threshold. You will need to work out the area of native vegetation cleared - refer to the BMAT user guide for how to do this.

On and after the 90 day expiry date a BDAR will be required.

Disclaimer

This results summary and map can be used as guidance material only. This results summary and map is not guaranteed to be free from error or omission. The State of NSW and Department of Planning and Environment and its employees disclaim liability for any act done on the information in the results summary or map and any consequences of such acts or omissions. It remains the responsibility of the proponent to ensure that their development application complies will all aspects of the *Biodiversity Conservation Act 2016.*

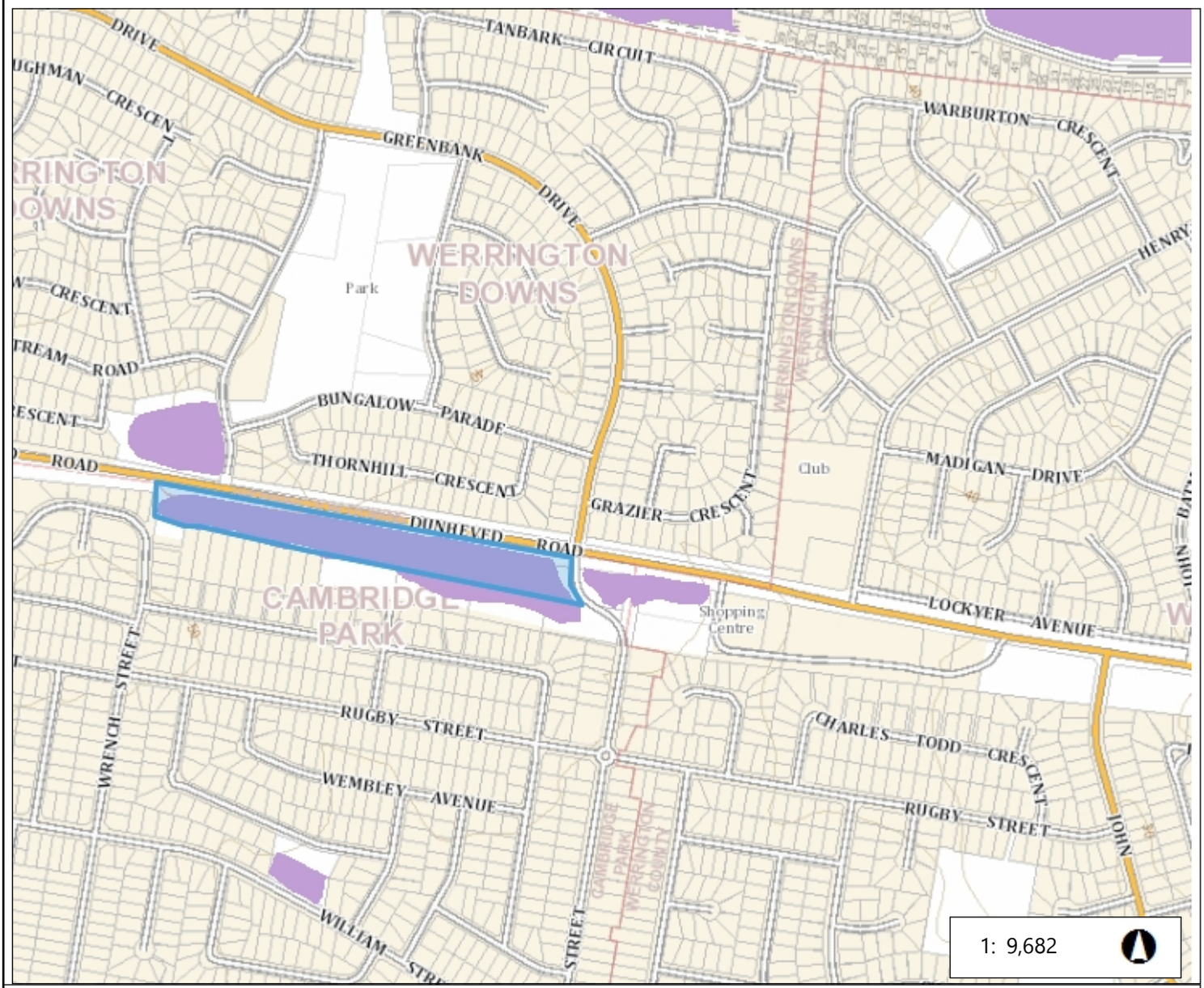
The mapping provided in this tool has been done with the best available mapping and knowledge of species habitat requirements. This map is valid for a period of 30 days from the date of calculation (above).

Acknowledgement

I as the applicant for this development, submit that I have correctly depicted the area that will be impacted or likely to be impacted as a result of the proposed development.

Signature_____ Date:13/07/2022 12:55 PM

Biodiversity Values Map



491.8 0 245.91 491.8 Metres

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Biodiversity Values that have been mapped for more than 90 days
- Biodiversity Values added within last 90 days

Notes

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	13/07/2022 1:00 PM	**BDAR Required***
Total Digitised Area	29,747.3 sqm	
Minimum Lot Size Method	LEP	
Minimum Lot Size 10,000sqm = 1ha	550 sqm	
Area Clearing Threshold 10,000sqm = 1ha	2,500 sqm	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes	yes
Date of the 90 day Expiry	N/A	

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
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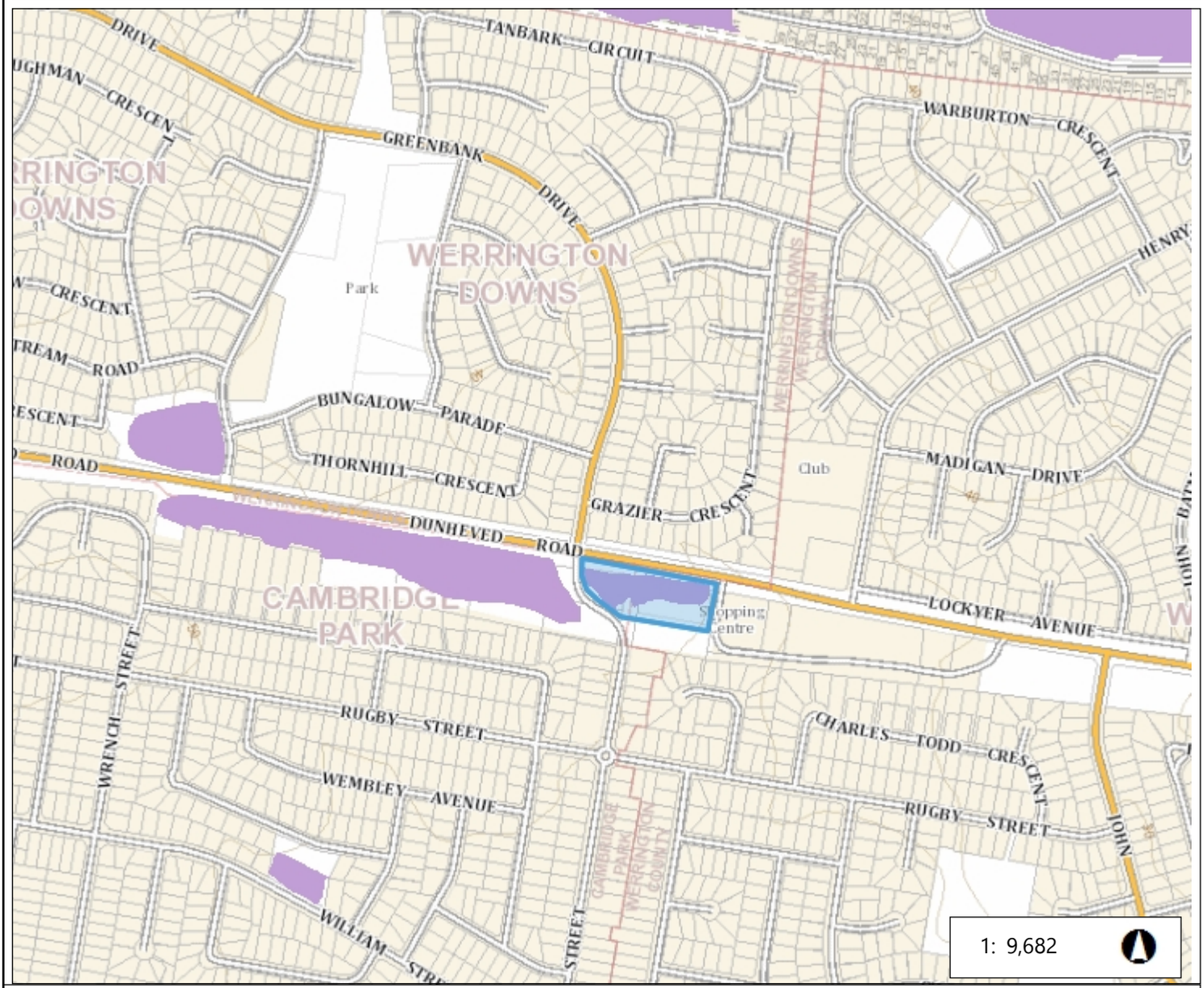
Signature_____ Date:13/07/2022 01:00 PM

Biodiversity Values Map



491.8 0 245.91 491.8 Metres

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Legend

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- Biodiversity Values added within last 90 days

Notes

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	13/07/2022 1:07 PM	**BDAR Required***
Total Digitised Area	10,676.9 sqm	
Minimum Lot Size Method	Lot size	
Minimum Lot Size 10,000sqm = 1ha	4,507 sqm	
Area Clearing Threshold 10,000sqm = 1ha	2,500 sqm	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes	yes
Date of the 90 day Expiry	N/A	

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
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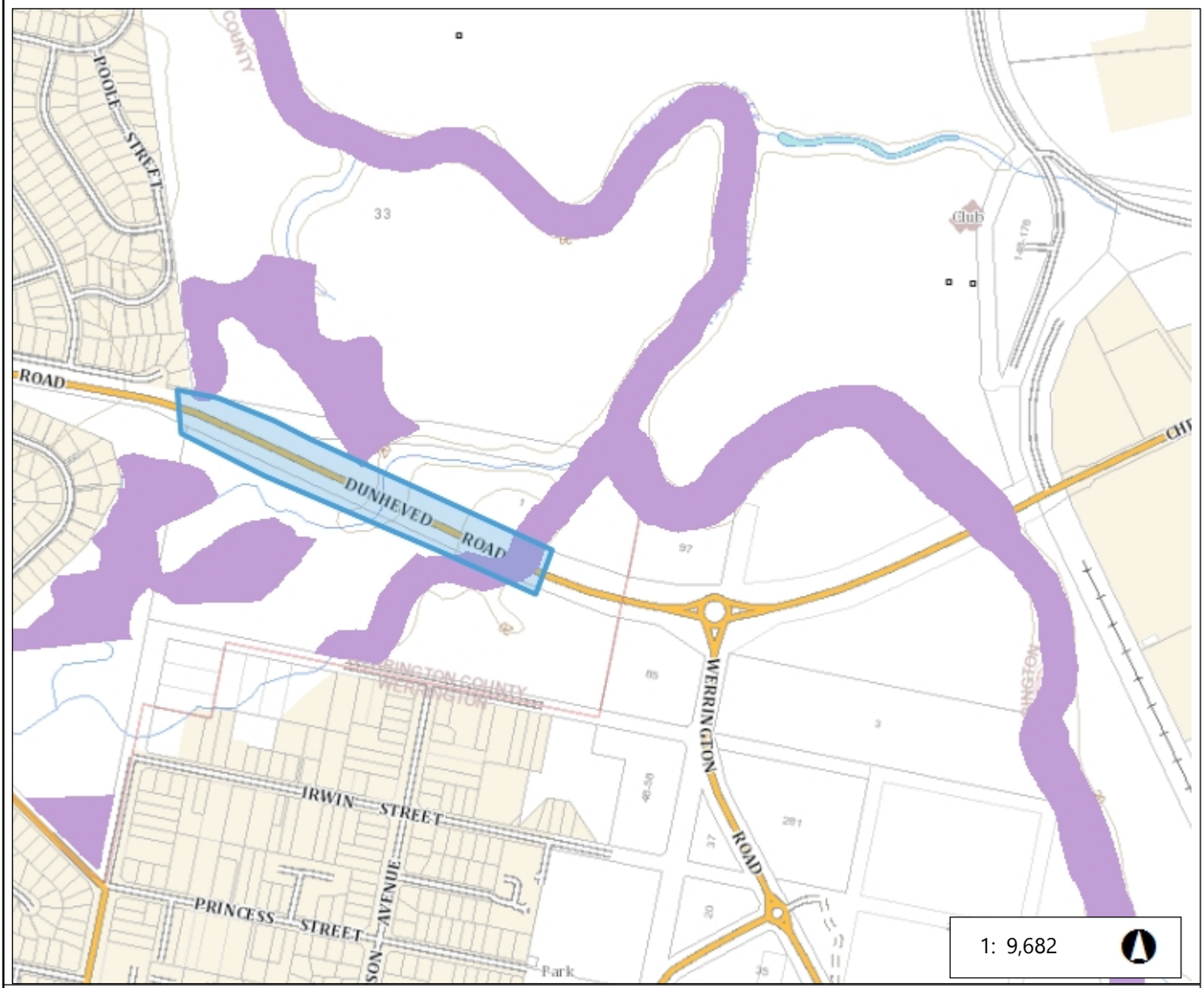
Biodiversity Values Map



491.8 0 245.91 491.8 Metres

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Legend

- Biodiversity Values that have been mapped for more than 90 days
- Biodiversity Values added within last 90 days

Notes

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	13/07/2022 1:10 PM	**BDAR Required***
Total Digitised Area	34,332.8 sqm	
Minimum Lot Size Method	Lot size	
Minimum Lot Size 10,000sqm = 1ha	141 sqm	
Area Clearing Threshold 10,000sqm = 1ha	2,500 sqm	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes	yes
Date of the 90 day Expiry	N/A	

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
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Signature_____ Date:13/07/2022 01:10 PM

APPENDIX

E

VEGETATION PLOT DATASHEETS

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Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	12/01/2022	**Survey name**	Dunheved Rd upgrade			**Plot identifier**	1		
Recorders	Adriana Corona Mathis Kate Shaw				**IBRA region**			**Veg zone ID**			
[1]**Datum**	94	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	[1]**X coordinate**	289983	[1]**Y coordinate**	6263794		
Location description	descriptive notes to locate site without grid reference: adjacent to Dunheved Rd										
[1]**Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m					[1]**Orientation of midline from 0 m point**	Magnetic° 315E	**Photo #**	✓		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate:** Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [6] large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [6] large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [6] large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space / Total 0 m
						[6] Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	99 99 94 95 98	1 1 0 5 2	0 0 0 0 0	0 0 0 0 0
Average of the 5 subplots	98	2	0	0

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)			**EEC** Tick ✓	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	vegetated
Lithology		Soil surface texture		Soil colour	light brown - orange	Soil depth	
Slope	flat	Aspect	E	Site drainage	towards Rd	Distance to nearest water and type	1.85 km

Disturbance	Severity code	Age code
Clearing (inc. logging)	2-3	O-R
Cultivation (inc. pasture)	0	-
Soil erosion	1	O-R
Firewood / CWD removal	0	-
Grazing (id. native/stock)	0	-
Fire damage	0	-
Storm damage	0	-
Weediness	3	R-O
Other	Waste	

Brief site description or other notes

Clearing - evident on patch edge. Possibly road maintenance cutting grass along road's edge

Waste present (plastics (bags, bottles); garden (garden escapees, pots); vehicle part (fragments))

Surrounded by built environment; Dunheved road; backyard/ fences

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	26 m	m	m	3 m	m	m	2 m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Logs
> 10 Diameter
> half metre length

Stag count = ++++ |||

BAM Plot - Field Survey Form

Sheet C Page 3 of ____

Date: 12-Jan-2022 **Recorders:** ACM **Plot ID:** 1

Project No: 800 **Project Name:** Dunheved Rd Upgrade **Zone ID:** ____

GF Code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	Statum	Voucher
T	Eucalyptus fibrosa (ironbark) /IIII	N	10	6		
T	Eucalyptus molucanna (Grey box)	N	40	9		
S	Bursaria spinosa 65 + /	N	10	66		
G	Eragrostis curvula (African Lovegrass) ;20;10;30;17	E	10	77		
F	Mother of millions (Bryophyllum delagoense) 60;3;6;II	E	0.1	71		
G	Themeda triandra 29;2;7;IIII	N	0.1	43		
G	Paspalum dilatatum /	E	0.1	1		
F	gl Senecio cunninghamii ;30;20;30;/	N	0.2	81		
G	Sporobolus creber 10	N	0.1	10		
G	gl Sida rhombifolia 2;2;6;/	E	0.1	11		
F	Bidens pilosa 15	E	0.1	15		
F	Plantago 6;3;14;6;II	E	0.1	31		
F	Sida rhombifolia II 5	E	0.1	7		
F	Asparagus aethiopicus III IIII	E	2	8		
V	Hardenbergia violacea //	N	0.1	2		
F	Dianella revoluta ;7;1	N	0.1	8		
G	Echinopogon caespitosus ;5;1	N	0.1	6		
G	Digitaria sp. 3	N	0.1	3		
G	Aristida ramosa // IIII	N	0.1	7		
F	Commelina cyanea ;3;2;4;5	N	0.1	14		
F	Goodenia heterochaeta 15;10	N	0.2	25		
F	Phyllanthus virgatus ;2;//	N	0.1	4		
G	Ehrharta erecta 10	E	0.1	10		
G	Cymbopogon refractus ///	N	0.1	3		
F	Stackhousia muricata /	N	0.1	1		
F	Dichondra repens 10;5	N	0.1	15		
V	Glycine clandestina /;1	N	0.1	7		
S	Acacia® parramattensis //	N	0.1	2		
F	Lomandra multiflora //	N	0.1	3		
F	Hypoxis hygrometrica /	N	0.1	1		
F	① indentified herb 20	E	0.1	20		
F	Caesia sp /	N	0.1	1		
V	Araujia sericifera /	E	0.1	1		
G	Rhytidosperma ;2	N	0.1	3		
S	Acacia decurrens	N	0.1	1		
S	Dillwynia sieberi	N	0.1	1		
S	Melia azedarach (Chinaberry Tree)	E	0.1	1		
S	Caesalpinia gilliesii (Bird-of-paradise shrub)	E	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 of BAM (OEH 2017) **N**: native, **E**: exotic, **HTE**: high threat exotic **GF - circle code** if 'top 3

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ..., 100% (foliage cover); **Note**

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Euc regen /

① < 0.3m H;

X Opuntia

X Agapanthus praecox

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	12/01/2022	**Survey name**	Dunheved Rd Upgrade			**Plot identifier**	2
Recorders	Adriana Corona Motte, Kate Shaw			**IBRA region**				**Veg zone ID**	
[1]**Datum**	94	**Coordinate system**	□ Projected ☑ Geographic	**MGA zone**	56	[1]**X coordinate**	290234	[1]**Y coordinate**	6263753
Location description	descriptive notes to locate site without grid reference								
[1]**Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m					[1]**Orientation of midline from 0 m point**	Magnetic° 82°E	**Photo #**	✓

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick
			Total high threat weed cover		%	[5]Length of fallen logs	Tally space / Total — m
						[6]Hollow bearing trees	Tick —

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	40 99 99 60 99	60 1 1 40 1	0 0 0 0 0	0 0 0 0 0
Average of the 5 subplots	78.4	20.6	0	0

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8]**Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		EEC	Tick ✓	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	vegetated
Lithology	Clayey soils	Soil surface texture		Soil colour	light brown-orange	Soil depth	
Slope	flat	Aspect	E	Site drainage		Distance to nearest water and type	1km

Disturbance	Severity code	Age code
Clearing (inc. logging)	2	R-O
Cultivation (inc. pasture)	0	
Soil erosion	0	
Firewood / CWD removal	0	
Grazing (id. native/stock)	0	
Fire damage	0	
Storm damage	0	
Weediness	2-3	O-R
Other	waste	

Brief site description or other notes

Waste present.
A Poaceae grass dominant ground; some large patchs of Asparagus aethiopicus.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Stag = 1111

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 12 01 2022	Dunhaved Rd Upgrade	2	ACM

GF Code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
T	Eucalyptus molluccana 10; //	N	30	12		
T	Eucalyptus ~~globoidea~~ fibrosa //	N	5	2		
G	Eragrostis curvula (African lovegrass)	E	60	>10,000		
G	Rhytidosperma tenuius /// ////	N	0.1	14		
F	Fleabane (Conyza canadensis) ///; 6; 3	E	0.1	12		
F	Sida rhombifolia 10; 5; 20; /	E	0.1	36		
F	Solanum nigrum /	E	0.1	1		
F	Brunoniella australis 12; 30; 20; 9; 4; 6; 20; 10	N	0.5	106		
F	Mother of Millions 3; //	E	0.3	35		
F	Asparagus aethiopicus ///	E	0.3	4		
F	Commelina cyanea 10; /// ////	E	0.2	18		
F	Einadia hastata (Berry Saltbush) ///	N	0.1	4		
G	Lepidosperma compressus 10; ///	N	0.1	13		
V	Glycine microphylla //	N	0.1	2		
F	Alternanthera denticulata 50; /	E	0.1	51		
F	unidentified herb 12; 10; ///	E	0.1	27		
G	Paspalum ///	N	0.1	5		
F	Phyllanthus virgatus /	N	0.1	1		
G	Themeda triandra 4	N	0.1	4		
S	Bursaria spinosa 20+ /; 3; /	N	0.3	25		
F	Dianella caerulea //	N	0.1	2		
F	~~Brassica~~ Lepidium africanum /	E	0.1	1		
G	Chloris gayana //	E	0.1	2		
S	Acacia concinna /	E	0.1	1		
F	Arthropodium milleflorum (Pale Vanilla Lily) // ///	N	0.1	7		
F	Dichondra repens 20	N	0.1	20		
G	Cymbopogon refractus //	N	0.1	2		
V	Passiflora /	E	0.1	1		
F	© Einadia nutans subsp. linifolia (Climbing Saltbush)	N	0.1	2		
F	Goodenia heterophylla 5	N	0.1	5		
S	Dillwynia sieberi 4	N	0.1	4		
F	Rumex acetosella (Sheep sorrel) //	E	0.1	2		
G	Fimbristylis dichotoma (Common Fringed-rush) /	N	0.1	1		
F	~~Verbena®~~ (~~Purpletop~~) /	~~E~~	~~0.1~~			
F	Dandelion /	E	0.1	1		
G	~~Barbwire~~ grass /	N	0.1	1		
F	® Heliotropium amplexicaule (Blue Heliotrope)	E	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***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*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...