Travers

bushfire & ecology

Biodiversity Assessment Report

Proposed Cemetery
1290 Greendale Road
Wallacia

November 2020
(REF: 20MKD03BDAR)

Biodiversity Assessment Report

Proposed Cemetery
Lot 1 DP 776645, 1290 Greendale Road, Wallacia

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Date:	09/11/20
File:	20MKD03BDAR

Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person, including the client, then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be interpreted without reference to the entire report.

The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

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Executive Summary

Travers bushfire & ecology has been engaged to prepare a Biodiversity Assessment Report (BAR) for a proposed cemetery at 1290 Greendale Road, Wallacia. The entire area bounded by Lot 1 DP 776645 has been subject to detailed survey effort and will hereafter be referred to as the 'study area'.

The area of direct impact from the development will hereafter be referred to as the 'development footprint'.

Development proposal

The proposed development is for an estimated 775,000 burial lot cemetery with roads, kerbs and services.

Recorded biodiversity

An ecological survey and assessment has been undertaken in accordance with the *Biodiversity Assessment Methodology* (BAM) as well as relevant legislation including the *Environmental Planning and Assessment Act 1979* (*EP&A Act*), the *Biodiversity Conservation Act 2016* (*BC Act*), the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) and the *Fisheries Management Act 1994* (*FM Act*). Compliant survey and limitations for candidate species are explained in Sections 2.5, Section 4.3.2 (flora) and Section 4.4.4 (fauna).

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *BC Act*, three (3) threatened fauna species White-bellied Sea Eagle (*Haliaeetus leucogaster*), Southern Myotis (Myotis macropus), and Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis)*, no threatened flora species, and two (2) threatened ecological communities (TECs), *Cumberland Plain Woodland* (CPW) and *Riverflat Eucalypt Forest* (RFEF), were recorded within the development footprint.

In respect of matters required to be considered under the *EPBC Act*, no threatened fauna species, no protected migratory bird species, no threatened flora species and one (1) threatened ecological community *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* listed under this Act were recorded within the development footprint.

In respect of matters relative to the *FM Act*, no suitable habitat for threatened marine or aquatic species was observed within the development footprint.

Impact assessment

Avoidance actions are outlined in Section 5.2. The resultant direct, indirect and cumulative ecological impacts of the proposal have been carefully considered in Section 5.3. Further recommended mitigation measures to minimise/offset these impacts, to address threatening processes and to create a more positive ecological outcome for threatened biodiversity have been outlined within Section 6.2.

The Development Proposal will see the impact of 0.65 ha of native vegetation, which includes impacts to four (4) different vegetation units including the following (PCT below refers to Plant Community Type):

- PCT 835 – Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Zone 2) TEC RFEF - 0.16 ha impacted
- PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Zone 3) TEC CPW - 0.26 ha impacted
- PCT 850 – Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (Zone 4) TEC CPW - 0.23 ha impacted

The assessment of significance test in accordance with Section 7.3 of the *BC Act* concluded that the proposal is unlikely to have a significant effect on CPW vegetation or other threatened biodiversity present.

There will be no significant impact on matters listed under the *FM Act*.

The proposal was not considered to have a significant impact on matters of national environmental significance, although a detailed *EPBC* assessment has not been undertaken as part of this BAR. As such a referral to Department of Environment and Energy should not be required.

Biodiversity Offsets Scheme (BOS) – Threshold Assessment

Based on the current proposed clearing, offsetting under the Biodiversity Offsets Scheme (BOS) is not required as:

1. the proposed clearing of vegetation is less than the area threshold of 1 ha,
2. clearing of native vegetation has been avoided within the mapped Biodiversity Values area, and
3. the proposal will not cause a significant impact on threatened biodiversity, as assessed in Appendix 2.

The proposed bridge crosses biodiversity values land over Duncans Creek. In this instance we have liaised with the client to ensure that the bridge crossing will be of adequate height and design to avoid impact to native vegetation adjacent to and below the bridge. The bridge must pass between the canopies of two large eucalypts (see Figure 2.2) and must be no more than 10 m wide. The current proposal complies with these specifications. In accordance with this design parameters, there will be no clearing of native vegetation or prescribed impacts due to the bridge crossing, and an offset is not required as an outcome of this threshold test.

List of abbreviations

APZ	asset protection zone
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act (2016)*
BC Reg	*Biodiversity Conservation Regulation (2017)*
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BPA	bushfire protection assessment
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically endangered ecological community
CM Act	*Coastal Management Act 2016*
DAWE	Department of Agriculture, Water and the Environment.
DCP	development control plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from April 2007)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from October 2009)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from April 2011)
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOEE	Commonwealth Department of Environment & Energy (superseded by DAWE)
DPIE	NSW Department of Planning, Industry and Environment
EEC	endangered ecological community
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act (1979)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act (1999)*
FM Act	*Fisheries Management Act*
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	local environmental plan
LGA	local government area
LLS Act	*Local Land Services Act (2013*)
NES	national environmental significance
NPW Act	*National Parks and Wildlife Act (1974)*
NRAR	Natural Resources Access Regulator (NSW)
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (superseded by DPIE from August 2019)
PCT	plant community type
PFC	projected foliage cover
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SAII	Serious And Irreversible Impacts
SEPP	State Environmental Planning Policy
SEWPAC	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE)
SIS	species impact statement
SULE	safe useful life expectancy
TEC	threatened ecological community
TPZ	tree preservation zone
TSC Act	*Threatened Species Conservation Act (1995) – Superseded by the Biodiversity Conservation Act (2016)*
VMP	vegetation management plan

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Introduction 1

Travers bushfire & ecology has been engaged to undertake a biodiversity development assessment within Lot 1 DP 776645, at 1290 Greendale Road, Wallacia within The City of Penrith local government area (LGA). The extent of this entire lot is shown in Figure 1.1 below. This lot is subject to a proposed cemetery development application and will hereafter be referred to as the 'study area'.

The area containing the proposed development and all associated roads and infrastructure impact on habitat features is hereafter referred to as the 'development footprint' (refer to Figure 1.4).

The proposal shall be assessed under the *Biodiversity Conservation Act* (*BC Act*), 2016.

Figure 1.1 – Study area (red)

1.1 Purpose

The purpose of this Biodiversity Assessment Report (BAR) are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions
- Carry out a fauna habitat survey for the detection and assessment of fauna and their potential habitats
- Complete targeted surveys for threatened species, populations and ecological communities
- Prepare a BAR in accordance with the requirements of the:
  a) *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*),
  b) *Biodiversity Conservation Act 2016* (*BC Act*),
  c) *Biodiversity Conservation Regulation 2017* (BC Reg.),
  d) *Fisheries Management Act 1994* (*FM Act*), and
- Prepare a BAR in accordance with the Biodiversity Assessment Methodology (BAM)

1.1.1 Terminology

Throughout this report the terms development footprint and study area are used. It is important to have a thorough understanding of these terms as they apply to the assessment.

Development footprint means the area directly affected by the proposal. It has the same meaning as "subject land" defined below.

Study area is the portion of land that encompasses all surveys undertaken and is usually all land contained within the designated property boundary. The study area extends as far as is necessary to assess all important biodiversity values known and likely to occur within the subject land and includes the development footprint and any additional areas which are likely to be affected by the proposal, either directly or indirectly.

Subject land is land to which the BAM is applied in Stage 1 to assess the biodiversity values. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement. In this case, it refers to the area designated as the development footprint, and has the same meaning for the purposes of this report. The terms "subject land" and "development footprint" are interchangeable in this regard.

Direct impacts are those that directly affect the habitat and individuals. They include, but are not limited to, death through clearing, predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.

Indirect impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.

1.2 Site description

1.2.1 Site overview

Table 1.1 provides an overview the planning, cadastral and topographical details of the study area and an overview of the site and surrounds is shown on Figure 1.5 and Figure 1.6 (site and location maps).

Table 1.1 – Site features

Location	Lot 1 DP 776645, 1290 Greendale Road, Wallacia
Location description	The site is located approximately 3.7 km directly south of Wallacia town centre. The site is surrounded on the northern, eastern and southern sides by rural parcels of land and by the Nepean River to the west.
Area	73.46 ha
Local government area	Liverpool
Zoning	RU1 – Primary Production
Grid reference MGA-56	281853.705 m E 6246564.069 m S
Elevation	Approximately 33-75m AHD
Topography	The site has a steep hill running from the north eastern corner sloping down west and south into a flood plain. There is a ridgeline running north to south adjacent to the banks of the Nepean River on the western edge of the lot.
Catchment and drainage	The site drains via Duncans Creek to the north and into the Nepean River.
Existing land use	Grazing, pasture, residential.

1.2.2 Landscape features

Table 1.2 examines the landscape features of the proposed development site in accordance with the BAM.

Table 1.2 – Landscape features

Patch size	>100, >100, <5
IBRA bioregions and subregions	Sydney Basin bioregion – Cumberland subregion (Figure 1.5 and Figure 1.6)
NSW landscape region and area (ha)	Hawkesbury - Nepean Channels and Floodplains
Native vegetation extent in the buffer area (1500m)	55.48 ha approx. and 30%
Cleared areas	Approximately 65.6 ha of land within the study area is cleared
Evidence to support differences between mapped vegetation extent and aerial imagery	Mapped vegetation closely matches aerial imagery. Unmapped trees and shrubs are exotic species.
Rivers and streams classified according to stream order	The site map (Figure 1.5) shows the study area with first, second, third and fourth order streams
Wetlands within, adjacent to and downstream of the	There are two dams within the eastern portions of the site, shown on the site map (Figure 1.5). There is a depression within the southern western portions that

site	collects water and acts as a disturbed and managed wetland.
Connectivity features	Refer to Section 5.4 and Figure 5.2.
Geology and soils	There are no features of geological importance, nor soil hazards within the study area. Geology; Quaternary alluvium: Fine-grained sand, silt and clay over most of the site. Wianamatta group Bringelly Shale in north east and south-central areas. Soils; Richmond in the western 2/3; Luddenham in the eastern 1/3.
Identification of method applied (i.e. linear or site-based)	Site based assessment

1.2.3 Zoning

The site is currently zoned RU1 under the Liverpool LEP of 2008 (refer to Figure 1.2) which is for primary production. Cemeteries are permitted with consent under this zoning.

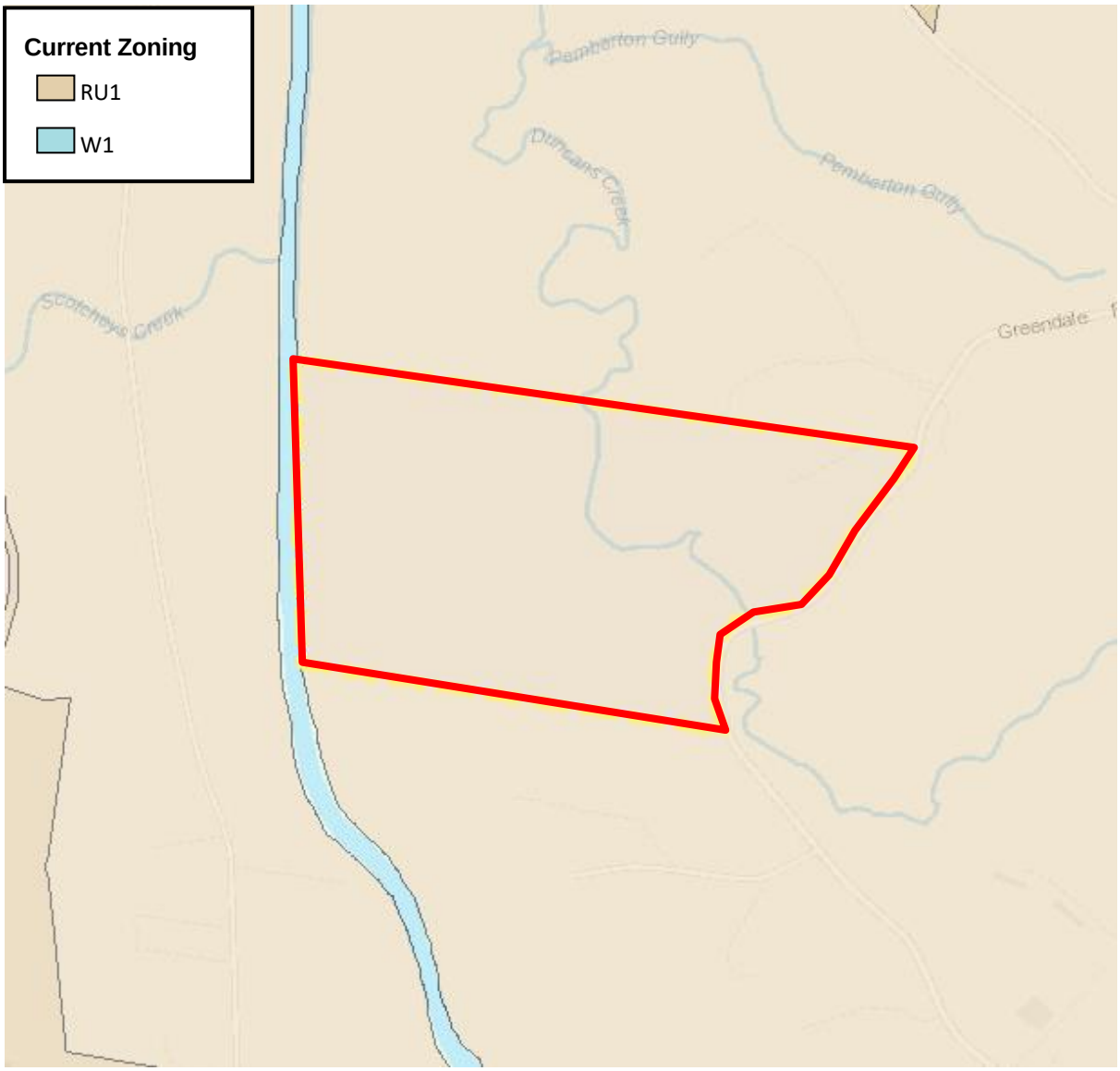


Figure 1.2 – Zoning

(Source: Planning Portal, 2020)

1.3 Proposed development

The Concept Master Plan proposal comprises of a cemetery, crematoria, community facilities, administration buildings, halls, chapels and other buildings and structures all associated with the operation of a cemetery with a garden, parkland and landscape setting. The proposal also includes internal roads, lakes and ponds. The site will support up to 750,000 burial plots. Cemeteries and associated civil works are permissible in the current RU1 zoning.

The initial development proposal is shown on Figure 1.3. This proposed large scale burial areas located over portions of all TEC vegetation communities (with the except the river community PCT 1108) as well as category 1 and 2 streams in the north-eastern portions of the site.

1.3.1 Identification of development site footprint

As a result of preliminary ecological survey and constraints analysis the development footprint has been refined from the previous proposal. The current development layout is shown on Figure 1.4.

Whilst the entire site is 73.46 ha, the amount of native vegetation is estimated at 7.87 ha. 0.65 ha of this will be directly impacted through the construction of internal roads, buildings and burial areas.

Previously proposed piped stormwater connection to Duncans Creek ant the Nepean River are to be revised to be overland to avoid impacts to mapped biodiversity values areas. As such, there will be no stormwater works within biodiversity values land.

Bridge crossing over Duncans Creek

The proposal includes a raised bridge over the Duncans Creek and associated riparian area study area. This area is located on lands mapped as Biodiversity Values Land (refer to Figure 5.1). The proposal otherwise avoids these mapped lands.

Detailed assessment of the area directly within and surrounding the proposed crossing has been undertaken to determine if any impacts will occur to native vegetation. This survey indicates that most vegetation in the immediate vicinity is exotic, including exotic pasture outside of the riparian zone, and exotic trees and shrubs within the riparian zone. Only a few native trees are close to or overhanging the area of the proposed bridge. The bridge, however, must pass between the canopies of two large eucalypts (see Figure 2.2) and must be no more than 10 m wide. The current proposal complies with these specifications and we have liaised with the client to ensure that the bridge crossing will be of adequate height and design to avoid impact to native vegetation adjacent to and below the bridge. The bridge support pylons will be located outside of the mapped Biodiversity Values Land, thus avoiding any additional impacts as prescribed in clause 6.1 of the *BC Reg*, and will only impact on exotic pasture.

This is discussed in further detail in section 5.1.1 of this BAR.

Figure 1.3 – Initial proposed development layout

Figure 1.4 – Proposed Masterplan Concept

1.4 Statutory assessment requirements

1.4.1 Environmental Planning and Assessment Act 1979 (EP&A Act)

Prior to any development taking place in New South Wales a formal assessment needs to be made of the proposed work to ensure it complies with relevant planning controls and, according to its nature and scale, confirm that it is environmentally and socially sustainable. State, regional and local planning legislation indicates the level of assessment required, and outlines who is responsible for assessing the development. The development assessment and consent system is outlined in Part 4 and the infrastructure and environmental impact assessment system is outlined in Part 5 of the *EP&A Act*.

1.4.2 Biodiversity Conservation Act 2016 (BC Act)

The *BC Act* repeals the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and the animal and plant provisions of the *National Parks and Wildlife Act 1974*.

The *BC Act* and the *BC Reg* establishes a regulatory framework for assessing and offsetting impacts on biodiversity values due to proposed developments and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme.

In the early stages of the project the proponent needs to determine whether the Scheme applies to their proposed activity (https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-offsets-scheme/how-it-works).

The Scheme applies to:

- Local development (assessed under Part 4 of the *Environmental Planning and Assessment Act 1979*) that is likely to significantly affect threatened species or triggers the Biodiversity Offsets Scheme threshold.
- State significant development and state significant infrastructure projects, unless the Secretary of the Department of Planning, Industry and Environment and the Environment Agency Head determine that the project is not likely to have a significant impact
- Biodiversity certification proposals
- Clearing of native vegetation in urban areas and areas zoned for environmental conservation that exceeds the Biodiversity Offsets Scheme threshold and does not require development consent
- Clearing of native vegetation that requires approval by the Native Vegetation Panel under the *Local Land Services Act 2016*
- Activities assessed and determined under Part 5 of the *Environmental Planning and Assessment Act 1979* (generally, proposals by government entities), if proponents choose to 'opt in' to the Scheme.

For local development, the BOS includes two (2) elements to the threshold test – an area trigger and a Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the Biodiversity Offset Scheme applies to the proposed clearing.

Development consent cannot be granted for non-State significant development under Part 4 of the *EP&A Act* if the consent authority is of the opinion it is likely to have serious and irreversible impacts (SAII) on biodiversity values. The determination of SAII is to be made in accordance with principles prescribed section 6.7 of the *BC Regulation 2017*. The principles have been designed to capture those impacts which are likely to contribute significantly to

the risk of extinction of a threatened species or ecological community in New South Wales. Assessment of SAIIs is only required where the BOS is entered.

The threatened species test of significance is used to determine if a development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. It is applied as part of the Biodiversity Offsets Scheme entry requirements and for Part 5 activities under the *EP&A Act* .

The test of significance is set out in s.7.3 of the *BC Act.* If the activity is likely to have a significant impact, or will be carried out in a declared area of outstanding biodiversity value, the proponent must either apply the Biodiversity Offsets Scheme or prepare a species impact statement (SIS).

The environmental impact of activities that will not have a significant impact on threatened species will continue to be assessed under s.111 of the *EP&A Act*.

1.4.3 Fisheries Management Act 1994 (FM Act)

The *FM Act* provides a list of threatened aquatic species that require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, an SIS is required to be prepared.

1.4.4 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions. It provides an assessment and approvals system for actions that have a significant impact on matters of *national environmental significance* (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on an NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) for assessment. In the case where no listed federal species are located on site then no referral is required. The onus is on the proponent to make the application and not the Council to make any referral.

A threshold criterion applies to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC*-listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with DOEE may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact or whether a referral is required, a referral is generally recommended to provide a

definite decision under the *EPBC Act* thereby removing any further obligations in the case of 'not controlled' actions.

A significant impact is regarded as being:

> *important, notable, or of consequence, having regard to its context or intensity and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.*
>
> *Source: EPBC Policy Statement*

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site http://www.environment.gov.au/epbc/publications.

1.4.5 Coastal Management Act 2016 (CM Act)

The *Coastal Management Act* (*CM Act,* 2016) establishes the framework and overarching objects for coastal management in New South Wales. The Act commenced on 29 June 2018 and replaces the previous *Coastal Protection Act* (1979).

The purpose of the *CM Act* is to manage the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of New South Wales.

The *CM Act* also supports the aims of the *Marine Estate Management Act 2014*, as the coastal zone forms part of the marine estate.

The *CM Act* defines the coastal zone, comprising four (4) coastal management areas:

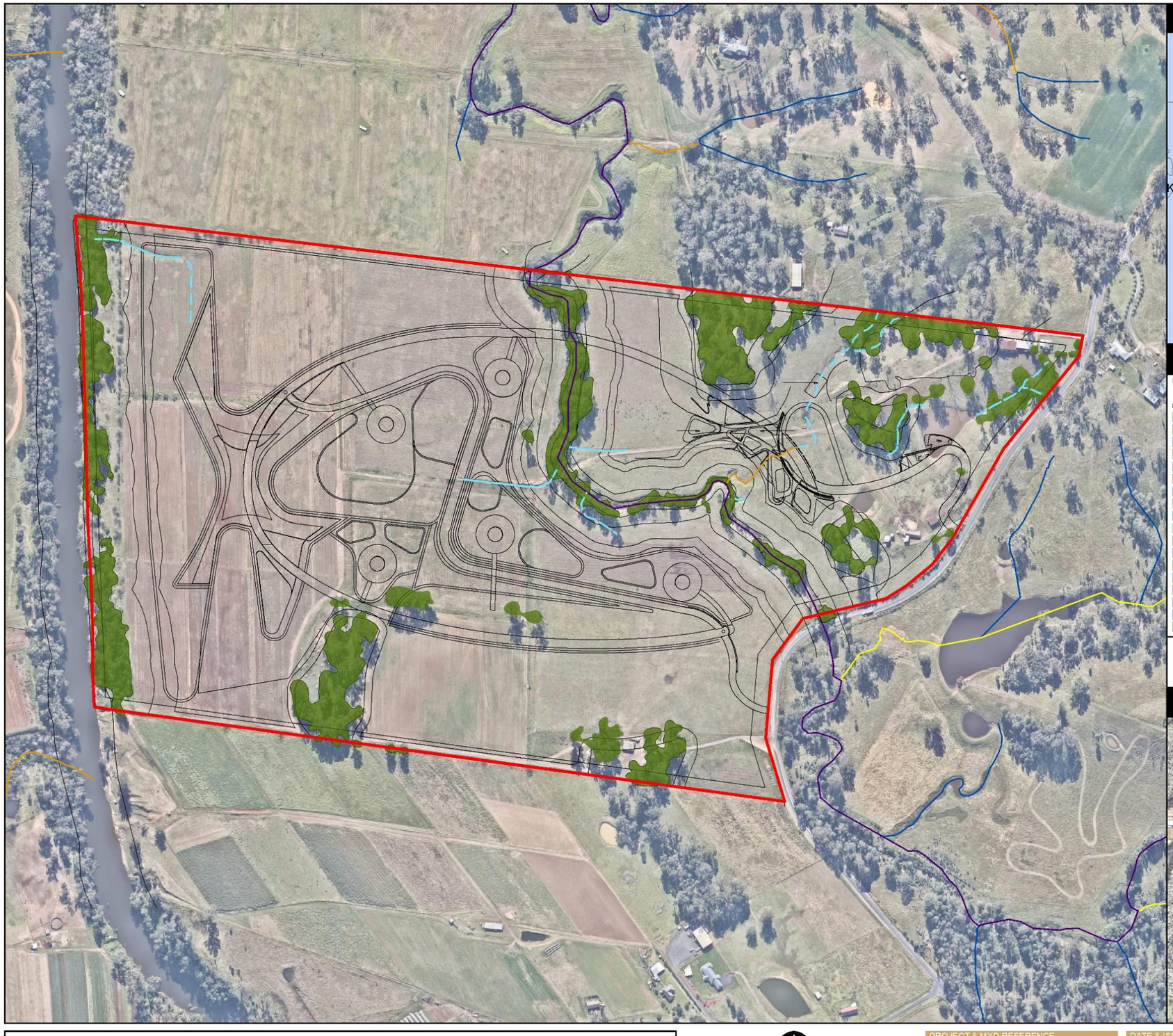
1. coastal wetlands and littoral rainforests area; areas which display the characteristics of coastal wetlands or littoral rainforests that were previously protected by SEPP 14 and SEPP 26
2. coastal vulnerability area; areas subject to coastal hazards such as coastal erosion and tidal inundation
3. coastal environment area; areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included
4. coastal use area; land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The *CM Act* establishes management objectives specific to each of these management areas, reflecting their different values to coastal communities.

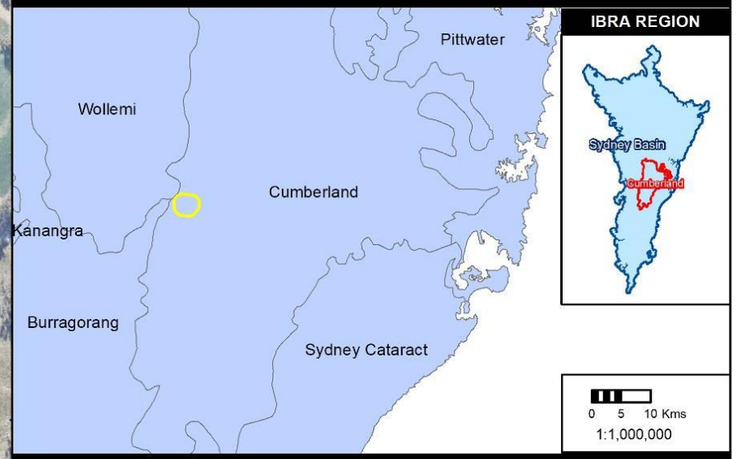
1.4.6 Licences

Individual staff members of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: SL100848.

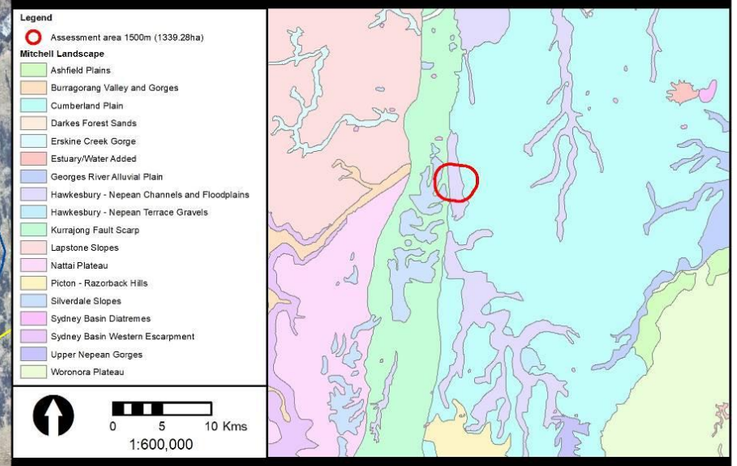
Travers bushfire & ecology staff are licensed under an Animal Research Authority issued by the NSW Department of Primary Industries. This authority allows *Travers bushfire & ecology* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.



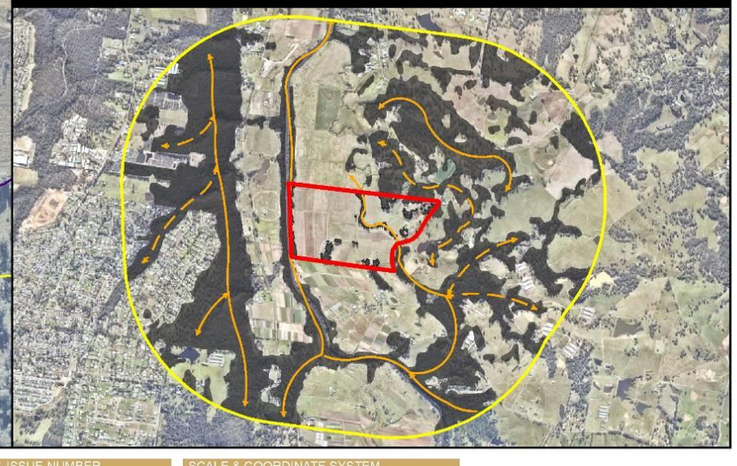
IBRA SUBREGIONS



MITCHELL LANDSCAPE MAPPING



HABITAT CORRIDORS AND CONNECTIVITY



Legend

- Assessment area 1500m (1339.28ha)
- Site boundary (73.34ha) (source:CAD)
- Verified native vegetation within site boundary - 7.88ha *(Travers bushfire & ecology, 2020)*

Stream Order (Source: TBE and LPI)

- Drainage line
- First order
- Second order
- Third order
- Fourth order

Habitat corridors & connectivity

- Corridors

Connectivity

- Primary
- Secondary

Aerial source: Nearmap

0 100 200 Meters

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE	DATE & ISSUE NUMBER	SCALE & COORDINATE SYSTEM
1290 Greendale Rd, Wallacia 20MKD03_BAM001	9/11/2020 Issue 1 SC	1:5,500 @A3 GDA 1994 MGA Zone 56

TITLE

Site Map

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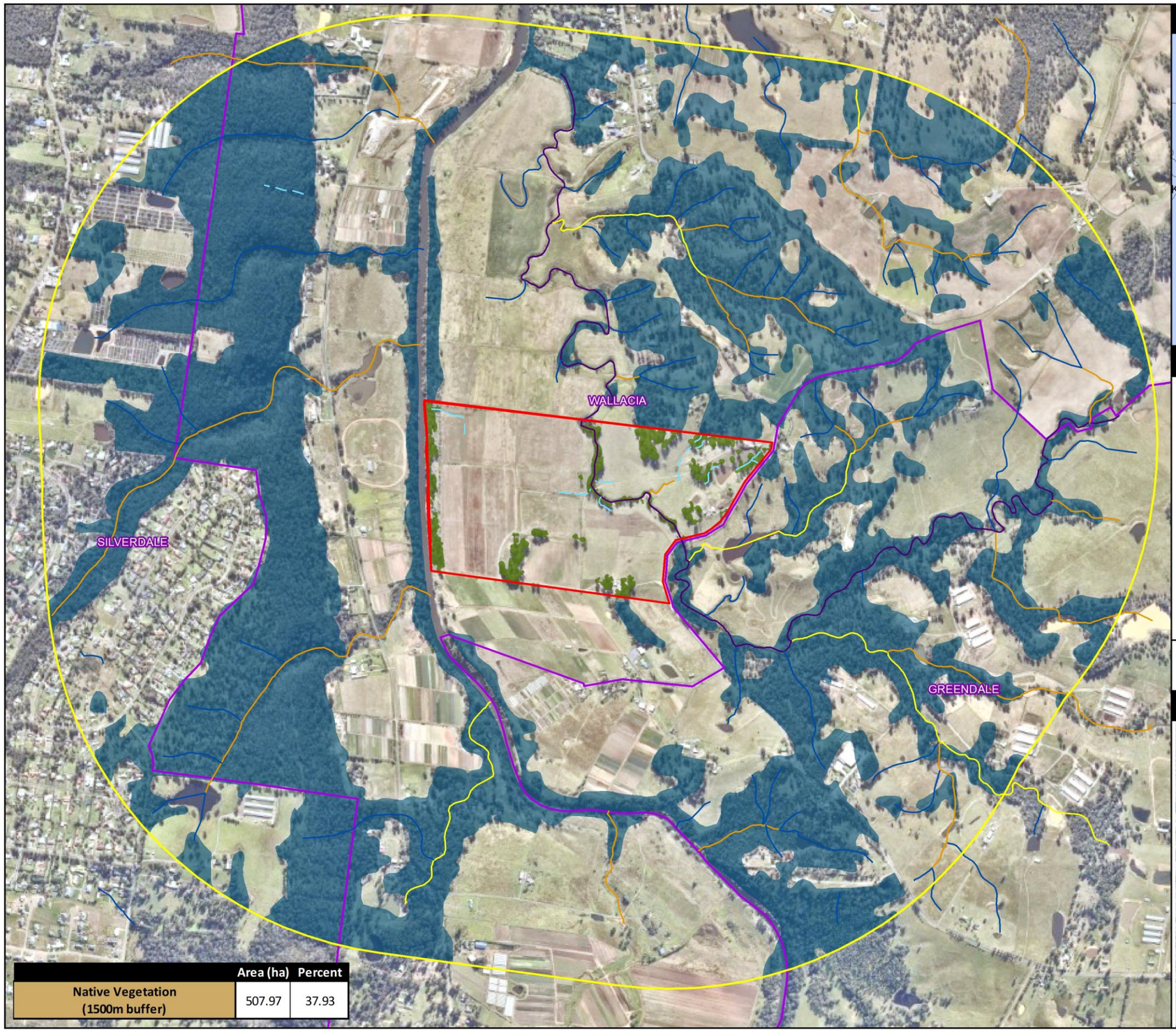
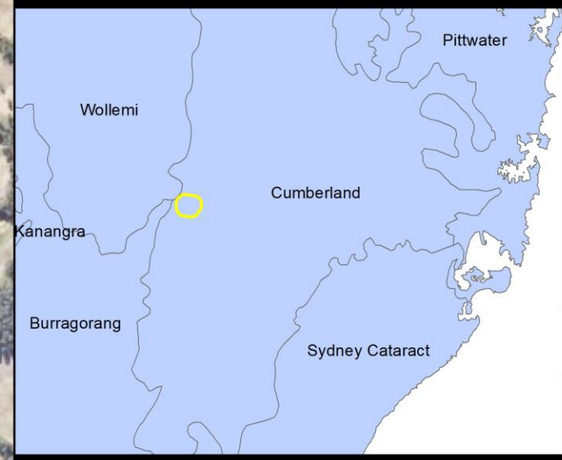
Travers bushfire & ecology

Figure 1.5 – Site map



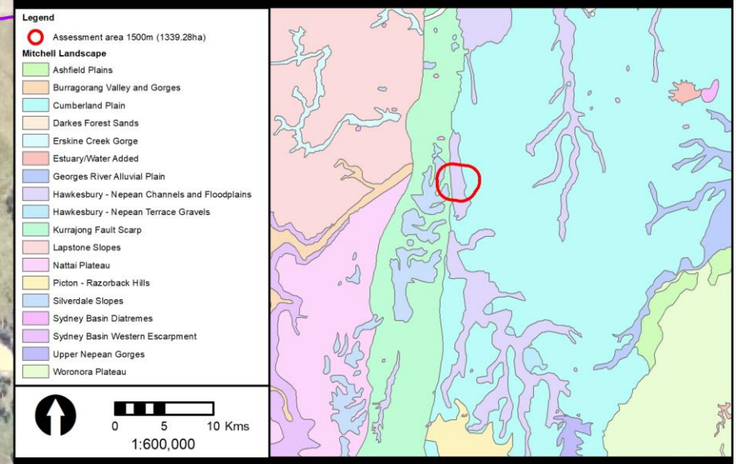
	Area (ha)	Percent
Native Vegetation (1500m buffer)	507.97	37.93

IBRA SUBREGIONS

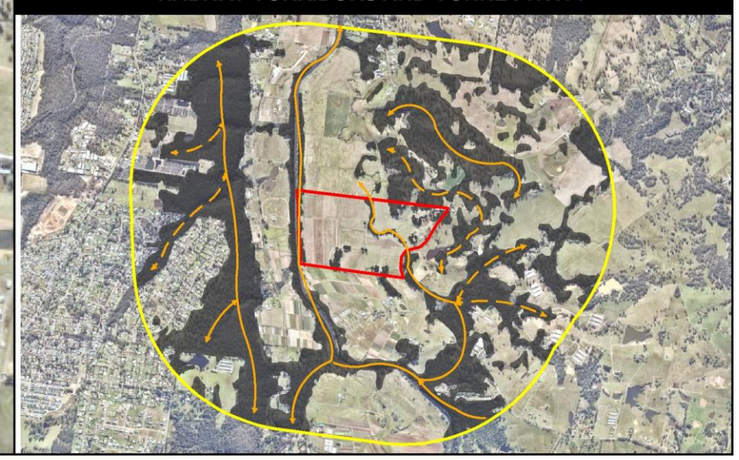


IBRA REGION

MITCHELL LANDSCAPE MAPPING



HABITAT CORRIDORS AND CONNECTIVITY



Legend

- Assessment area 1500m (1339.28ha)
- Site boundary (73.81ha) (source:LPI)
- Suburbs boundary (source:LPI)
- Verified native vegetation within site boundary - 7.88ha *(Travers bushfire & ecology, 2020)*
- Native vegetation in 1500m assessment area, outside of site (500.09ha)

Stream Order (Source: TBE and LPI)

- Drainage line
- First order
- Second order
- Third order
- Fourth order

Habitat corridors & connectivity

- Corridors

Connectivity

- Primary
- Secondary

Aerial source: Nearmap

0 200 400 Meters

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE	DATE & ISSUE NUMBER	SCALE & COORDINATE SYSTEM
1290 Greendale Rd, Wallacia 20MKD03_BAM002	9/11/2020 Issue 1 SC	1:16,000 @A3 GDA 1994 MGA Zone 56

TITLE

Location Map

Document Path: N:\GIS STORAGE\N Drive\20MKD03_GreendaleRd_Wallacia\MXDs\20MKD03_BAM002.mxd

Travers bushfire & ecology

Figure 1.6 – Location map

Survey Methodology 2

2.1 Pre-survey information collation & resources

Documents reviewed:

- Masterplan and landscape plan prepared by *MKD Architects*
- Bushfire Protection Assessment prepared by *Travers bushfire & ecology*
- Vegetation Management Plan prepared by *Travers bushfire & ecology*

Technical resources utilised:

Legislation

- *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*)
- *Biodiversity Conservation Act 2016* (*BC Act*)
- *Biodiversity Conservation Regulation 2017* (*BC Reg.*)
- *Fisheries Management Act 1994* (*FM Act*)

Survey guidelines

- *Survey guidelines for Australia's threatened birds* (DEWHA 2010)
- *Survey guidelines for Australia's threatened fish* (DEWHA 2011)
- *Survey guidelines for Australia's threatened frogs* (DEWHA 2010)
- *Survey guidelines for Australia's threatened mammals* (DEWHA 2011)
- *Survey guidelines for Australia's threatened bats* (DEWHA. 2010)
- *Survey guidelines for Australia's threatened reptiles* (DEWHA 2011)
- *Matters of National Environmental Significance* (Commonwealth of Australia 2013)
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians* (DECC – April 2009a)
- *Hygiene Protocol for the Control of Diseases in Frogs* (DECC 2008)
- *Region based guide to the echolocation calls of Microchiropteran bats* (DEC 2004)
- *Species credit threatened bats and their habitats* (DPIE 2018)

Mapping resources

- Aerial photographs (Google Earth Pro / Spatial Information Exchange / NearMap)
- Topographical maps (scale 1:25,000)
- LiDAR data for contours (Land and Property Information, est. 2015 estimated)
- ESpade – OEH tool for checking soil types

Threatened species records

- *BioNet* database which holds data from a number of custodians
- EPBC *Protected Matters Search Tool - DAWE*

Vegetation mapping/resources

- BioNet Vegetation Classification System

- *Vegetation mapping of the Cumberland Plain* (NSW National Parks and Wildlife Service 2002)
- NSW Guide to Surveying Threatened Plants (DPIE 2016)

Vegetation mapping:

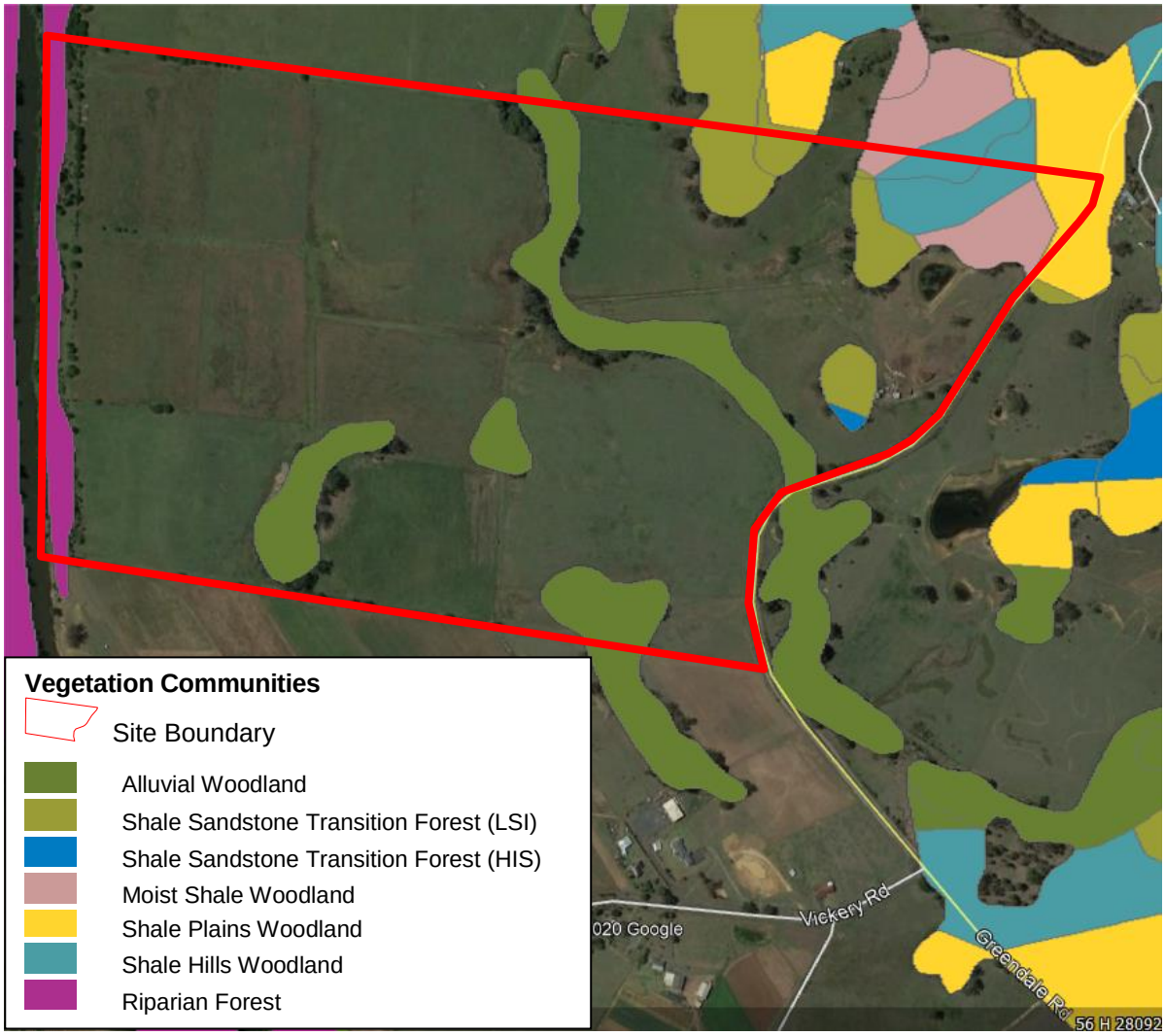


Figure 2.1 – Vegetation Mapping of the Cumberland Plain (NSW NPWS 2002)

Vegetation mapping of the Cumberland Plain (NSW National Parks and Wildlife Service 2002) identifies the following communities within the study area (Figure 2.1):

- Alluvial Woodland
- Shale Sandstone Transition Forest (Low Sandstone Influence)
- Shale Sandstone Transition Forest (High Sandstone Influence)
- Moist Shale Woodland
- Shale Plains Woodland
- Shale Hills Woodland
- Riparian Forest

2.2 Flora survey methodology

Flora survey was undertaken on 8 and 9 August 2020. A review of the *Atlas of NSW Wildlife* (DPIE 2020) was undertaken prior to the site visit to determine threatened species previously recorded within 10 km of the subject site, and relevant target searches were undertaken as suited, generally as near-linear transects underneath or adjacent to remnant canopy vegetation.

Stratified survey using the BAM was undertaken. The following information was collected at each of seven (7) BAM plots:

- Native overstorey, mid-storey and ground cover recorded for all observed species and an estimate of stems (20 m x 20 m)
- Stratum (and layer): stratum and layer in which each species occurs (20 m x 20 m)
- Growth form: growth form for each recorded species (20 m x 20 m
- Species name: scientific name and common name (20 m x 20 m)
- Percent projected foliage cover of the understorey strata and exotic vegetation (20 m x 20 m
- Number of trees with hollows visible from the ground (20 m x 50 m)
- The total length of fallen logs >10 cm in diameter (20 m x 50 m)
- The presence or absence of regenerating trees (20 m x 50 m)
- Presence of trees in difference size classes (20 m x 50 m)
- Number of large trees (20 m x 50 m)
- Estimates of leaf litter cover, bare ground, cryptograms and rocks in 1 m x 1 m subplots at five (5) locations along the central transect (20 m x 50 m)

Targeted survey for threatened species was undertaken as parallel transects within the all vegetation zones (refer to
Figure 2.2).

Additional survey was undertaken on 7 October 2020 to assess vegetation within the locality of, and directly adjacent to, the proposed bridge crossing. This involved three (3) flora plots of 20 m x 20 m to measure plant composition and cover. Nearby trees to the proposed bridge crossing were located with GPS and measured for height with a clinometer. These trees are mapped on Figure 2.2 inset.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1 and are depicted on
Figure 2.2.

Diurnal birds

Three (3) diurnal bird census points were undertaken within the development footprint on the 21st July 2020 and an additional three (3) on the 13th August 2020. A minimum of 15 minutes of survey was undertaken at each census point in an area radiating out to between 30-50m. Bird census points were selected to give an even spread and representation across the site and its communities (see
Figure 2.2). Census points were also commenced in locations where bird activity was apparent, as often different small bird species are found foraging together. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

Two (2) song-meters were deployed totalling 46 recording days over mid-July to mid-August. These recorded the complete diurnal period from sunrise to sundown. Song meters were evenly distributed across the site targeting its communities. These locations are shown on Figure 2.

Nocturnal birds

Given the suitability of habitat present Masked Owl (*Tyto novaehollandiae*) and Barking Owl (*Ninox connivens*), were targeted by call-playback techniques during site visits in July and August. Spotlighting was undertaken during both of these times.

Given that a nearby hollow-bearing tree (marked as SHT22) provided Owl roosting potential stag-watching was undertaken on 21st July 2020. On the 13th of August a small cluster of medium to large hollows were stag watched in the south western corner of the site. Dusk listening and spotlighting were undertaken during these times.

Two (2) song-meters were deployed totalling 46 recording nights over mid-July to mid-August. These recorded the complete diurnal period from sunrise to sundown. Song meters were evenly distributed across the site targeting its communities. These locations are shown on Figure 2.

Diurnal survey included searches for any signs of Powerful Owl roosting activity. This was undertaken where dense mid-storey foliage was present, typically in the gully and Dry Rainforest portions of the site.

Arboreal and terrestrial mammals

Given the suitability of habitat present Koala (*Phascolarctos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were then targeted by call-playback techniques and spotlighting on the 21st of July 2020. These species were surveyed by dusk listening and spotlighting on the 13th of August 2020.

Target Koala survey was undertaken to satisfy the SEPP (Koala Habitat Protection) 2019 (refer to Section 4.3.3.c).

The Spot Assessment Technique described by *Phillips & Callaghan* (2008) was undertaken as a measure of Koala 'activity'. In this case the proportion of trees showing signs of Koala use is calculated and the location and density of droppings found were documented. The first SAT was applied in the largest remnant patch of PCT 850 which contained Grey Box and Forest Red Gum trees and provided connectivity to the north-east.

Due to the narrow linear nature of vegetation along the margins of the Nepean River and also given the number of exotic trees (*Robinia pseudoacacia*) with a DBH >10cm present, the standard SAT did not appear most appropriate. This was fundamentally because the eucalypt trees present along this strip were also linear and often well separated such that a point SAT selecting all closest trees above 10cm DBH would only represent a very small number of potential feed trees. Therefore instead, all eucalypt trees along the full river interface were searched for Koala activity. This amounted to a total of eight trees represented by Forest Red Gum, River Peppermint, Camden White Gum and Rough-barked Apple. The searches were therefore slightly more than the equivalent to a Rapid-SAT technique.

Rapid-SAT is a survey technique outlined but not yet published by Koala expert Stephen Phillips (who devised the full SAT technique) and staff at Biolink. It is an occupancy-

focused assessment tool informed by the presence/absence of diagnostic koala faecal pellets around the bases of Preferred Koala Food Tree (PKFT) species. The Rapid-SAT approach is predicated by knowledge that in areas being utilised by koalas, there is an ~ 50% probability of faecal pellets occurring within 1 m of the base of any PKFT species ≥ 300 mm diameter at breast height (DBH) (Phillips & Wallis 2016).

In applying the technique, assessment at a given point ceases upon one or more koala faecal pellets being detected within the prescribed search area (1 m) around the base of each PKFT that is searched. Conversely, if no pellets are detected, sampling ceases once a minimum of five to (ideally) a maximum of seven PKFTs ≥ 300 mm DBH have been assessed, these numbers affording a high level of statistical confidence (95% or 99% respectively) that koalas are not using habitat in the immediate vicinity (Phillips & Wallis 2016). All eight trees sampled were >300 mm DBH except one Camden White Gum which was 270 mm. Only one tree however was a local PKFT (Forest Red Gum). Hence the river riparian habitat would not be regarded as highly preferred Koala habitat.

A final Rapid-SAT was also undertaken in the largest patch of PCT 835 which all seven trees selected were the largest PKFT Forest Red Gum trees present in this patch. These ranged between a DBH of 450 mm to 1000 mm.

Bats

Mega-chiropteran bat species, such as Grey-headed Flying-fox, are surveyed by targeting flowering / fruiting trees during spotlighting activities and by listening to distinctive vocalisations. Suitable roosting habitat is searched for presence of small or large established camps during diurnal survey periods.

Spotlighting was undertaken across the study site between July and August to assess key foraging areas on site.

Micro-chiropteran bats are surveyed by echolocation using ultrasonic recording detectors. Three (3) were deployed in fixed 'passive' monitoring positions for a total of 69 recording nights targeting key foraging areas across the site such as flyways through vegetation and open water.

Amphibians

There is no suitable habitat for threatened frog species within the study area. However opportunistic habitat searches were undertaken during other diurnal surveys. Call identification was also undertaken during nocturnal spotlighting activities.

Reptiles

There is no suitable habitat for threatened reptile species within the study area. However opportunistic habitat searches were undertaken during other diurnal surveys.

Invertebrates

As the understory of the study site was regularly maintained for livestock, habitat for threated invertebrate species such as the Cumberland Plain Land Snail (*Meridolum corneovirens*) was in poor condition. However, opportunistic habitat searches were undertaken within woodland areas within the site. Logs, stumps, artificial refuse and rocks were turned over and rotten sections of logs were peeled away. Larger movable logs were most targeted. Some dense areas of leaf litter with likely moisture retaining properties were also opportunistically scraped using a three-pronged rake.

Significant habitat trees

Significant habitat trees were identified throughout the study area. These are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10–30 cm) sized hollow. A tree may also be considered significant where evidence of use by select fauna is found. No such trees were however recorded.

Data such as the number of hollows present in each size category (or other reason for selection), tree species, diameter at breast height, canopy spread and overall height were collected. Significant habitat tree results are identified in Table 3.6.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the development footprint.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
Diurnal birds	21/7/20	1/8 cloud, 10km S wind, no rain, temp 17°C	Diurnal census x3, Diurnal opportunistic	4hrs 45mins 1230 - 1715
	21/7-13/8/20	mostly fine	Song-meter	46 recording nights
	13/8/20	1/8 cloud, no wind, no rain, temp 18-12°C	Diurnal census x3, Diurnal opportunistic	3hrs 45min 1345 - 1730
Nocturnal birds	21/7/20	1/8 cloud, 10km S wind, no rain, temp 17°C	Roost habitat search	4hrs 45mins 1230 - 1715
		0/8 cloud, 6km E wind, no rain, ¾ moon, temp 10-9°C	Spotlighting	2hrs 1715 - 1930
			Call playback (Section 2.5 species)	Commenced @ 1830
	21/7-13/8/20	mostly fine	Song-meter	46 recording nights
	13/8/20	1/8 cloud, no wind, no rain, temp 12-8°C	Dusk listening / Spotlighting	1hr 30min 1730 - 1900
			Call playback (Section 2.5 species)	Commenced @ 1810
Arboreal mammals	21/7/20	0/8 cloud, 6km E wind, no rain, ¾ moon, temp 10-9°C	Spotlighting	2hrs 1715 - 1930
			Call playback (Section 2.5 species)	Commenced @ 1830
	21/7-13/8/20	mostly fine	Song-meter	46 recording nights
	13/8/20	1/8 cloud, no wind, no rain, temp 18-12°C	Koala SATx1, rapid SATx2	3 Koala SAT points
		1/8 cloud, no wind, no rain, temp 12-8°C	Dusk listening / Spotlighting	1hr 30min 1730 - 1900
Terrestrial mammals	21/7/20	0/8 cloud, 6km E wind, no rain, ¾ moon, temp 10-9°C	Spotlighting	2hrs 1715 - 1930
	13/8/20	1/8 cloud, no wind, no rain, temp 12-8°C	Spotlighting	1hr 30min 1730 - 1900
Bats	21/7/20	0/8 cloud, 6km E wind, no rain, ¾ moon, temp 10-9°C	Spotlighting	2hrs 1715 - 1930
	21/7-13/8/20	mostly fine	Ultrasonic microbat recording (Passive monitoring) x3	69 recording nights
	13/8/20	1/8 cloud, no wind, no rain, temp 12-8°C	Spotlighting	1hr 30min 1730 - 1900
Reptiles	21/7/20	1/8 cloud, 10km S wind, no rain, temp 17°C	Diurnal opportunistic / habitat searches	4hrs 45mins 1230 - 1715
	13/8/20	1/8 cloud, no wind, no rain, temp 18-12°C	Diurnal opportunistic / habitat searches	3hrs 45min 1345 - 1730
Amphibians	21/7/20	1/8 cloud, 10km S wind, no rain, temp 17°C	Diurnal opportunistic / habitat searches	4hrs 45mins 1230 - 1715
		0/8 cloud, 6km E wind, no rain, ¾ moon, temp 10-9°C	Spotlighting / call identification	2hrs 1715 - 1930
	13/8/20	1/8 cloud, no wind, no rain, temp 12-8°C	Spotlighting / call identification	1hr 30min 1730 - 1900
Molluscs	21/7/20	1/8 cloud, 10km S wind, no rain, temp 17°C	Opportunistic habitat searches	4hrs 45mins 1230 - 1715
	13/8/20	1/8 cloud, no wind, no rain, temp 18-12°C	Opportunistic habitat searches in woodland areas	3hrs 45min 1345 - 1730

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	- Survey of the boundaries of all communities – field verification, plotting vegetation boundaries on aerial photographs	8–9 Aug 2020
Stratified sampling	- Seven (7) 20m x 20m / 50m x 20m floristic transect plots within native vegetation using BAM - Three (3) 20m x 20m floristic plots in vegetation in location of proposed watercourse crossing	8–9 Aug 2020 7 Oct 2020
Targeted searches	- Targeted searches in known or potential habitats using parallel belt transects. - Opportunistic searches during all on-foot traverses across the site.	8–9 Aug 2020

2.5 Survey limitations

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

Flora survey limitations

The species list does not include all household or exotic garden / landscaping species and those species which could not be identified at the time of the survey past genus level. Cryptic species not flowering at the time of the survey may not be observed during survey outside of peak flowering periods. Likewise, cryptic orchid species are generally only recognisable when flowering.

There are not likely to be any limitations to threatened flora species survey which could change the outcomes of significance assessment as survey has been undertaken within the appropriate period for species with potential to occur.

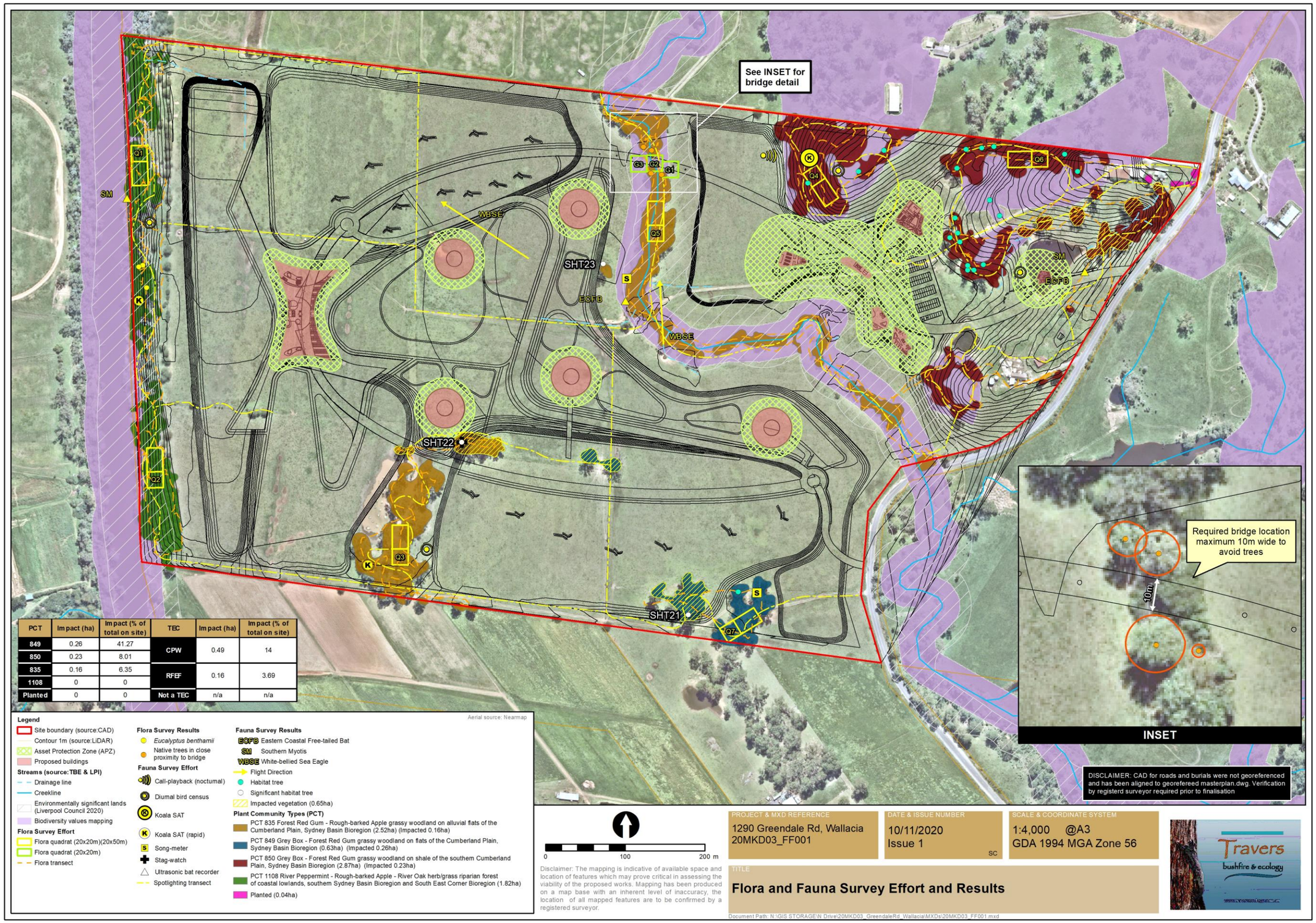
Fauna survey limitations

Microbat survey was undertaken during winter when activity is typically low. Two (2) detectors were left out for 23 consecutive nights to overcome this limitation. Likely concentrated activity locations over waterbodies and along vegetated edges were targeted. It is however recognised that both activity and species diversity, possibly including other threatened species may occur in warmer month's conditions.

Hollow-dependent threatened species were recorded during survey. Only significant habitat trees were identified across the entire study area. These are trees containing large or numerous hollows. Some additional habitat trees have also been identified only within the north-eastern portions of the site but have not mapped. Due to the varying project designs, all hollows suitable for roosting, denning and/or breeding by threatened fauna within the current development footprint have not been identified. These should be identified and where noted of potential or suspected threatened fauna use they should be stag-watched to determine appropriate protection or relocation measures.

2.6 Accuracy of identification

Structural descriptions of the vegetation were made according to Specht *et al* (1995).



PCT	Impact (ha)	Impact (% of total on site)
849	0.26	41.27
850	0.23	8.01
835	0.16	6.35
1108	0	0
Planted	0	0

TEC	Impact (ha)	Impact (% of total on site)
CPW	0.49	14
RFEF	0.16	3.69
Not a TEC	n/a	n/a

Figure 2.2 – Flora and fauna survey effort and results

Survey Results 3

3.1 Flora results

3.1.1 Native vegetation extent

The native vegetation extent within the study area has been ground-truthed.

The native vegetation to be impacted measures 0.65 ha. This is a combination of impacts from roads, building envelopes, APZs, and impacts from future burial plots.

3.1.2 Flora species

The plants observed within the vegetation communities of the study area are listed in the Table 3.1 below.

Table 3.1 – Flora observations within the study area

Family	Scientific name	Common name
TREES		
Fabaceae	*Acacia parramattensis*	Sydney Green Wattle
Myrtaceae	*Angophora subvelutina*	Broad-leaved Apple
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle
Casuarinaceae	*Casuarina cunninghamiana* subsp. *cunninghamiana*	River Oak
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum
Myrtaceae	*Eucalyptus baueriana*	Blue Box
Myrtaceae	***Eucalyptus benthamii*** [TS]	**Camden White Gum**
Myrtaceae	*Eucalyptus elata*	River Peppermint
Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Myrtaceae	*Eucalyptus moluccana*	Grey Box
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
Meliaceae	*Melia azedarach*	White Cedar
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive
Fabaceae	*Robinia pseudoacacia**	Black Locust
SHRUBS		
Fabaceae	*Acacia binervia*	Coast Myall
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush
Solanaceae	*Datura* sp.*	Thornapple

Family	Scientific name	Common name
Verbenaceae	*Lantana camara**	Lantana
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Solanaceae	*Lycium ferocissimum**	African Boxthorn
Celastraceae	*Maytenus silvestris*	Orange Bush
Phytolaccaceae	*Phytolacca octandra**	Inkweed
Myrtaceae	*Sannantha pluriflora*	-
Solanaceae	*Solanum americanum*	Glossy Nightshade
Solanaceae	*Solanum chenopodioides**	Whitetip Nightshade
Solanaceae	*Solanum linnaeanum**	Apple of Sodom
Solanaceae	*Solanum mauritianum**	Wild Tobacco
Solanaceae	*Solanum nigrum**	Black-berry Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Solanaceae	*Solanum pseudocapsicum**	Jerusalem Cherry
GROUNDCOVERS		
Polygonaceae	*Acetosa sagittata**	Turkey Rhubarb
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Asteraceae	*Ageratina adenophora**	Crofton Weed
Amaranthaceae	*Alternanthera pungens**	Khaki Weed
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Brassicaceae	*Brassica tournefortii**	Mediterranean Turnip
Poaceae	*Bromus cartharticus**	Prairie Grass
Acanthaceae	*Brunoniella australis*	Blue Trumpet
Brassicaceae	*Capsella bursa-pastoris**	Shepherds purse
Brassicaceae	*Cardamine flexuosa**	Wood Bittercress
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed
Adiantaceae	*Cheilanthes sieberi*	Rock Fern
Chenopodiaceae	*Chenopodium album**	Fat Hen
Asteraceae	*Cirsium vulgare**	Spear Thistle
Convolvulaceae	*Convolvulus arvensis**	Field Bindweed
Asteraceae	*Conyza sumatrensis**	Tall Fleabane
Asteraceae	*Cotula australis*	Common Cotula
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus gracilis*	Slender Flat Sedge
Cyperaceae	*Cyperus* sp.*	-
Apiaceae	*Daucus carota**	Wild Carrot
Convolvulaceae	*Dichondra repens*	Kidney Weed
Poaceae	*Digitaria sanguinalis**	Crab Grass
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia trigonos*	Fishweed
Poaceae	*Eragrostis curvula**	African Lovegrass
Euphorbiaceae	*Euphorbia peplus**	Spurge
Asteraceae	*Gamochaeta* sp.*	Cudweed

Family	Scientific name	Common name
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Apiaceae	*Hydrocotyle tripartita*	Pennywort
Asteraceae	*Hypochaeris radicata**	Flatweed
Juncaceae	*Juncus usitatus*	Common Rush
Brassicaceae	*Lepidium bonariense**	Peppercress
Lobeliaceae	*Lobelia purpurascens*	Whiteroot
Poaceae	*Lolium perrenne**	Perennial Ryegrass
Malvaceae	*Malva parviflora**	Small-flowered Mallow
Poaceae	*Microlaena stipoides*	Weeping Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Poaceae	*Oplismenus aemulus*	Basket Grass
Cactaceae	*Opuntia stricta**	Prickly Pear
Oxalidaceae	*Oxalis perennans*	Yellow-flowered Wood Sorrel
Oxalidaceae	*Oxalis pes-caprae**	Soursob
Poaceae	*Paspalum dilatatum**	Paspalum
Euphorbiaceae	*Phyllanthus virgatus*	-
Plantaginaceae	*Plantago lanceolata**	Ribwort
Poaceae	*Poa annua**	Winter Grass
Ranunculaceae	*Ranunculus* sp.	
Polygonaceae	*Rumex brownii*	Swamp Dock
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Asteraceae	*Sigesbeckia orientalis* subsp. *orientalis*	Indian Weed
Asteraceae	*Silybum marianum**	Variegated Thistle
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Caryophyllaceae	*Stellaria media**	Common Chickweed
Asteraceae	*Tagetes minuta**	Stinking Roger
Asteraceae	*Taraxacum officinale**	Dandelion
Poaceae	*Themeda triandra*	Kangaroo Grass
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Fabaceae	*Trifolium repens**	White Clover
Urticaceae	*Urtica incisa*	Stinging Nettle
Verbenaceae	*Verbena bonariensis**	Purpletop
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell
VINES		
Asclepiadaceae	*Araujia sericifera**	Mothvine
Sapindaceae	*Cardiospermum grandiflorum**	Balloon Vine, Love in a Puff
Fabaceae	*Desmodium varians*	Slender Tick-trefoil
Solanaceae	*Solanum seaforthianum**	Climbing Nightshade
AQUATIC PLANTS		
Marsileaceae	*Marsilea hirsuta*	Short-fruited Nardoo

*** denotes exotic species**
[TS] denotes threatened species

3.1.3 Plant community types (PCTs)

Evidence used to identify a PCT

Evidence used to identify the PCTs within the site: the entire list of PTCs was exported from the online BioNet Vegetation Classification Tool. Dominant canopy species, mid-stratum species, ground cover species, and Interim Biogeographic Regionalisation for Australia (IBRA) region and sub-region (Cumberland) information were utilised to produce a short list of potential PCTs (Table 3.2). Final PCTs were then chosen based on species composition and presence, and similarity to descriptive attributes and distributional information provided in the BioNet Vegetation Classification Tool. Justification for inclusion or exclusion of each shortlisted PCT is provided in Table 3.2.

Table 3.3 provides a summary of the PCT occurring within the development site, including vegetation formation, percent cleared within and extent within the development site.

Table 3.2 – PCT shortlist and justification

Zone	Shortlisted PCTs	PCT name	Match	Justification
1	1107	River Peppermint - Narrow-leaved Peppermint open forest on sheltered escarpment slopes, Sydney Basin Bioregion and South East Corner Bioregion	*x*	Wrong landscape position: sheltered slopes on high ranges of the escarpment. Few diagnostic species.
	1108	**River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion**	✓	**Correct landscape position, presence of *Casuarina cunninghamiana,* correct vegetation class: Eastern Riverine Forests.**
	1301	White Ash - Silvertop Ash - Brown Barrel shrubby open forest of the escarpment ridges, South Eastern Highlands Bioregion and South East Corner Bioregion	*x*	Wrong landscape position: upper slopes and ridges in dissected terrain between 700 and 1200 m on the escarpment ranges. Few diagnostic species.
	1504	Sydney Blue Gum - Deanes Gum - River Peppermint shrubby riparian tall forest of the lower Colo River, Sydney Basin Bioregion	*x*	Wrong location: lower Colo River. Few diagnostic species.
2	**835**	**Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion**	✓	**Diagnostic species: *E. tereticornis, E. amplifolia, A. subvelutina, Acacia parramattensis, Bursaria spinosa*. Correct landscape position.**
3	830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*x*	Not shrubby. Wrong landscape position: sheltered, steep hillsides.
	849	**Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion**	✓	**Key diagnostic upper strata present. Correct landscape position: flats and plains.**

Zone	Shortlisted PCTs	PCT name	Match	Justification
	850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*x*	Wrong landscape position: hills and rises.
	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	*x*	No *Casuarina glauca*
4	830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*x*	Not shrubby. Wrong landscape position: sheltered, steep hillsides.
	849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	*x*	Wrong landscape position: flats and plains.
	850	**Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion**	✓	**Key diagnostic upper strata present. Correct landscape position: hills and rises.**
	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	*x*	No *Casuarina glauca*

Zone 1:

The vegetation within Zone 1 is highly disturbed and variable, with unusual floristic composition in places. The identification of the most suitable PCT was based upon filtering for PCTs with the most distinctive and uniformly present species, *Casuarina cunninghamiana,* as upper strata species within the Sydney Basin IBRA region. No PCTs exist with this combination of traits. All PCTs were then filtered for *Eucalyptus elata* as an upper strata species within the IBRA region. This produced a shortlist of four (4) PCTs: 1107, 1108, 1301 and 1504. Only 1108 is a match for the vegetation within Zone 1, due to the mention of "River Oak" (*Casuarina cunninghamiana*) in the PCT name (though, curiously, it is not in the upper strata diagnostics), landscape position on sandy alluvial flats, on floodplain margins and in riverine corridors, and vegetation class Eastern Riverine Forests.

PCT 1108 is equivalent to *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, which is listed as endangered under the *BC Act.*

Zone 2:

The identification of the most suitable PCT was based upon filtering for PCTs within the Cumberland IBRA sub-region with *Eucalyptus tereticornis* and *E. amplifolia* in the upper strata, and *Acacia parramattensis* and *Bursaria spinosa* in the mid strata. This produced one PCTs: PCT 835. This PCT is a good match for the vegetation within Zone 2. The landscape position, broad alluvial flats of the Hawkesbury and Nepean river systems, and narrower ribbons alongside streams and creeks that drain the Cumberland Plain, is correct for both the south-western patch and the riparian vegetation along Duncans Creek.

PCT 835 is also equivalent to *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, which is listed as endangered under the *BC Act.*

Zone 3:

The identification of the most suitable PCT was based upon filtering for PCTs within the Cumberland IBRA sub-region with *Eucalyptus tereticornis* and *E. moluccana* in the upper strata. This produced a shortlist of four PTCs: 830, 849, 850 and 1800. PCT 830 is not a match as this PCT is shrubby and occurs on sheltered, steep, hillsides and rises, whereas Zone 3 is grassy and flat. PCT 1800 can also be eliminated due to a lack of *Casuarina glauca.* PCTs 849 and 850 are closely associated components of the TEC Cumberland Plain Woodland, and both closely match the vegetation present. Ultimately, the location of Zone 3 on flats indicates that it is commensurate with PCT 849.

PCT 849 vegetation in Zone 3 is commensurate with *Cumberland Plain Woodland in the Sydney Basin Bioregion*, which is listed as critically endangered under the *BC Act,* but is not commensurate with *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* which is listed as critically endangered under the *EPBC Act.* See Section 4.2.3 for detailed discussion.

Zone 4:

The identification of the most suitable PCT was based upon filtering for PCTs within the Cumberland IBRA sub-region with *Eucalyptus tereticornis* and *E. moluccana* in the upper strata. This produced a shortlist of four PTCs: 830, 849, 850 and 1800. PCT 830 is not a match as this PCT is shrubby and occurs on sheltered, steep, hillsides and rises, whereas Zone 3 is grassy and flat. PCT 1800 can also be eliminated due to a lack of *Casuarina glauca.* PCTs 849 and 850 are closely associated components of the TEC Cumberland Plain Woodland, and both closely match the vegetation present. Ultimately, the location of Zone 4 on hills and rises indicates that it is commensurate with PCT 850.

PCT 850 vegetation in Zone 4 is commensurate with *Cumberland Plain Woodland in the Sydney Basin Bioregion*, which is listed as critically endangered under the *BC Act,* and *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* which is listed as critically endangered under the *EPBC Act.* See Section 4.2.3 for detailed discussion.

Table 3.3 – PCTs

PCT code	PCT name	Species relied upon	Veg. formation	Veg. class	% cleared	Area within development site (ha)	TEC status
1108	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	*E. elata, Casuarina cunninghamiana*	Forested Woodlands	Eastern Riverine Forests	50	1.82 on site, none to be impacted	River Flat Eucalypt Forest
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	*E. tereticornis E. amplifolia Angophora subvelutina, Acacia parramattensis, Bursaria spinosa*	Forested Wetlands	Coastal Floodplain Wetlands	93	2.51 on site, 0.16 to be impacted	River Flat Eucalypt Forest

PCT code	PCT name	Species relied upon	Veg. formation	Veg. class	% cleared	Area within development site (ha)	TEC status
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	*E. tereticornis, E. moluccana*	Grassy Woodlands	Coastal Valley Grassy Woodlands	93	0.63 on site,0.26 to be impacted	Cumberland Plain Woodland
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*E. tereticornis, E. moluccana*	Grassy Woodlands	Coastal Valley Grassy Woodlands	88	2.87 on site, 0.23 to be impacted	Cumberland Plain Woodland

3.1.4 Vegetation descriptions of observed communities

The following vegetation communities were identified within the development footprint through ground truthing. Threatened ecological communities are denoted with 'TEC'.

PCT 1108 – River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (Zone 1) TEC RFEF

This vegetation community occurs in the far western portion of the study area adjacent to the Nepean River. It is moderately disturbed due to past and ongoing land use practices (grazing) and flooding, and has a high abundance of naturalised exotic plants. The floristic composition is variable, with some unusual floristic combinations in places.

Photo 1 – ***PCT 1108 within plot 1 in the north-west of the study area.***

Photo 2 – ***PCT 1108 within plot 2 in the south-west of the study area.***

Canopy – 18 to 25 m high providing 20–50% projected foliage cover (PFC). Species include *Casuarina cunninghamiana, Eucalyptus elata* and *Eucalyptus benthamii.*

Mid - storey – Native *Backhousia myrtifolia, Melia azedarach, Bursaria spinosa*, *Acacia binervia, Maytenus sylvestris* provide 3–10% PFC. Naturalised exotics such as *Robinia pseudoacacia, Ligustrum sinense, Cardiospermum grandiflorum* and *Lantana camara* provide 20–40% PFC.

Groundcovers – Native *Microlaena stipoides*, *Cynodon dactylon, Austrostipa ramosissima, Themeda triandra*, *Rumex brownii, Oplismenus aemulus, Dichondra repens, Lobelia purpurascens, Cheilanthes sieberi, Sigesbeckia orientalis, Solanum americanum, Juncus usitatus, Oxalis perennans* and *Hydrocotyle tripartita* provide 5–14% PFC. Exotic species include *Setaria parviflora, Conyza* spp., *Poa annua, Ageratina adenophora, Senecio madagascariensis, Bidens pilosa* and *Tradescantia flumensis,* and provide 5–15% PFC.

Classification – PCT 1108 is also equivalent to *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, which is listed as endangered under the *BC Act.*

PCT 835 – Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Zone 2) TEC RFEF

This vegetation community occurs in the floodplain areas in the south-west of the study area, and within the riparian areas adjacent to Duncans Creek. This community is highly disturbed, with few understorey species and an abundance of naturalised exotics.

Photo 3 – ***PCT 835 within plot 3 in the south-west of the study area.***

Photo 4 – *PCT 835 within plot 5 in the riparian area along Duncans Creek*

Canopy – The canopy of the south-western patch is entirely comprised of *Eucalyptus tereticornis*. Along Duncans Creek there are additional species including *Casuarina cunninghamiana, Angophora subvelutina, E. amplifolia* and *E. baueriana.* Trees are 18–23 m tall and provide 40–65% PFC.

Mid-storey – The native mid-storey is largely absent, with occasional occurrences of *Bursaria spinosa, Acacia parramattensis, Callistemon salignus, Melaleuca linearifolia* and *Melaleuca styphelioides* providing < 3% PFC. Naturalised exotics such as *Ligustrum sinense, Robinia pseudoacacia* and *Olea europea* are common in the riparian area and provide up to 27% PFC.

Groundcovers – Native groundcovers include *Microlaena stipoides, Oplismenus aemulus, Rumex brownii, Solanum americanum, Sigesbeckia orientalis, Urtica incisa, Oxalis perennans, Juncus usitatus, Marsilea hirsuta, Einadia trigonos* and *Geranium homeanum,* providing 2–17 PFC. Naturalised exotics are abundant and include *Tradescantia flumensis, Ehrharta erecta, Sida rhombifolia, Euphorbia peplus, Trifolium repens, Silybum marianum, Chenopodium albens, Eragrostis curvula, Digitaria sanguinalis, Sonchus oleraceus, Capsella bursa-pastoris, Bidens pilosa, Cirsium vulgare, Modiola caroliniana* and *Veronica persica* providing 4–30% PFC.

Classification – PCT 835 is also equivalent to *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, which is listed as endangered under the *BC Act.*

PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Zone 3) TEC CPW

This vegetation occurs in the south-east of the study area and is comprised of canopy trees with a very disturbed understorey with no shrubs and very few native groundcovers.

Canopy – *E. moluccana* and *E. tereticornis* 18–25 m tall and providing 25% PFC.

Mid-storey – absent.

Groundcovers – Dominated by exotic grasses and groundcovers, including *Lolium perrenne, Plantago lanceolata, Senecio madagascariensis, Sida rhombifolia, Sonchus oleraceus, Lepidium bonariense, Ehrharta erecta, Cenchrus clandestinus* and *Malva parviflora*, providing 55% PFC. Native species provide 7% PFC and include *Oxalis perennans, Wahlenbergia gracilis, Cotula australis* and *Desmodium varians.*

Classification – PCT 849 vegetation in Zone 3 is commensurate with *Cumberland Plain Woodland in the Sydney Basin Bioregion*, which is listed as critically endangered under the *BC Act,* but is not commensurate with *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* which is listed as critically endangered under the *EPBC Act.* See Section 4.2.3 for detailed discussion.

Photo 5 – ***PCT 849 within plot 7 in the south-east of the study area.***

PCT 850 – Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (Zone 4) TEC CPW

This community occurs in the north-eastern portion of the study area on the gentle slopes and hills. As with the other communities onsite, the vegetation is highly disturbed from past and ongoing land use practices.

Photo 6 – ***PCT 850 within plot 4 in the north-east of the study area.***

Photo 7 – *PCT 850 within plot 6 in the north-east of the study area.*

Canopy – *E. moluccana* and *E. tereticornis* 18–25 m tall and providing 23–31% PFC.

Mid-storey – Native shrubs are largely absent. Exotic species provide 1–22% PFC and include *Olea europaea, Lycium ferocissimum* and *Lantana camara.*

Groundcovers – Native species include *Microlaena stipoides, Solanum prinophyllum, Einadia polygonoides, Oxalis perennans, Rumex brownii, Dichondra repens, Cyperus gracilis, Oplismenus aemulus, Cotula australis* and *Desmodium varians* providing 10–60% PFC. Exotic grasses and groundcovers include *Cirsium vulgare, Conyza sumatrensis, Plantago lanceolata, Solanum nigrum, Alternanthera pungens, Solanum linnaeanum, Paspalum dilatatum, Hypochaeris radicata, Senecio madagascariensis, Sida rhombifolia, Sonchus oleraceus, Lepidium bonariense, Ehrharta erecta, Cenchrus clandestinus* and *Malva parviflora*, providing 5–15% PFC.

Classification – PCT 850 vegetation in Zone 4 is commensurate with *Cumberland Plain Woodland in the Sydney Basin Bioregion*, which is listed as critically endangered under the *BC Act,* and *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* which is listed as critically endangered under the *EPBC Act.* See Section 4.2.3 for detailed discussion.

Planted native vegetation

This vegetation occurs in the far north east of the site close to the existing entrance. Is consists of planted *Eucalyptus microcorys* trees with grassy understorey.

Exotic vegetation

The remained of the site contains exotic vegetation, mostly in the form of managed pasture. Common species are *Bromus cartharticus, Lolium perrenne, Cenchrus clandestinus, Brassica tournefortii, Cirsium vulgare, Digitaria sanguinalis* and *Lepidium bonariense.* These areas are almost completely devoid of native species.

In areas adjacent to the Nepean River and within the riparian area of Duncans Creek, there are patches of exotic trees and shrubs. Common species include *Robinia pseudoacacia, Ligustrum* spp., *Celtis occidentalis, Lantana camara* and *Olea europaea*.

Photo 8 - Exotic vegetation near Duncans Ck in location of proposed bridge.

Photo 9 - Exotic vegetation near Duncans Creek in location of proposed bridge, showing gap between native eucalypt trees.

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed below.

Table 3.4 – Fauna recorded within the study area

Common name	Scientific name	Method observed
Birds		**July 20**
Australasian Grebe	*Tachybaptus novaehollandiae*	O
Australian Magpie	*Cracticus tibicen*	O W
Australian Owlet-nightjar	*Aegotheles cristatus*	O W
Australian Raven	*Corvus coronoides*	O W
Australian Wood Duck	*Chenonetta jubata*	O W
Bar-shouldered Dove	*Geopelia humeralis*	O W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O W
Brown Gerygone	*Gerygone mouki*	O W
Brown Thornbill	*Acanthiza pusilla*	O W
Common Myna *	*Sturnus tristis*	O W
Common Starling *	*Sturnus vulgaris*	O W
Crested Pigeon	*Ocyphaps lophotes*	O W
Double-barred Finch	*Taeniopygia bichenovii*	O W
Eastern Rosella	*Platycercus eximius*	O W

Common name	Scientific name	Method observed
Eastern Spinebill	*Acanthorhynchus tenuirostris*	W
Eastern Whipbird	*Psophodes olivaceus*	W
Eastern Yellow Robin	*Eopsaltria australis*	W
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	O W
Galah	*Eolophus roseicapillus*	O W
Golden Whistler	*Pachycephala pectoralis*	W
Grey Butcherbird	*Cracticus torquatus*	O W
Grey Fantail	*Rhipidura albiscapa*	O W
Grey Shrike-thrush	*Colluricincla harmonica*	O W
Grey Teal	*Anas gracilis*	O
Grey Goshawk	*Accipiter novaehollandiae*	O W
Laughing Kookaburra	*Dacelo novaeguineae*	O W
Little Black Cormorant	*Phalacrocorax sulcirostris*	O
Little Corella	*Cacatua sanguinea*	O W
Long-billed Corella	*Cacatua tenuirostris*	O W
Magpie-lark	*Grallina cyanoleuca*	O W
Masked Lapwing	*Vanellus miles*	O W
Noisy Miner	*Manorina melanocephala*	O W
Pacific Black Duck	*Anas superciliosa*	O W
Rainbow Lorikeet	*Trichoglossus haematodus*	O W
Red Junglefowl *	*Gallus*	W
Red-rumped Parrot	*Psephotus haematonotus*	O W
Red-whiskered Bulbul *	*Pycnonotus jocosus*	W
Satin Bowerbird	*Ptilonorhynchus violaceus*	W
Silvereye	*Zosterops lateralis*	O W
Spotted Pardalote	*Pardalotus punctatus*	O W
Straw-necked Ibis	*Threskiornis spinicollis*	O
Striated Pardalote	*Pardalotus striatus*	O W
Sulphur Crested Cockatoo	*Cacatua galerita*	O W
Superb Fairy-wren	*Malurus cyaneus*	O W
Tawny Frogmouth	*Podargus strigoides*	O W
Tree Martin	*Petrochelidon nigricans*	O W
Wedge-tailed Eagle	*Aquila audax*	O
Welcome Swallow	*Hirundo neoxena*	O
White-bellied Sea-Eagle TS/MS	*Haliaeetus leucogaster*	O
White-faced Heron	*Egretta novaehollandiae*	O W
White-necked Heron	*Ardea pacifica*	O
Willie Wagtail	*Rhipidura leucophrys*	O W
Yellow Thornbill	*Acanthiza nana*	O W
Yellow-faced Honeyeater	*Caligavis chrysops*	O W
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	W
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	W
Mammals		
Black Rat *	*Rattus*	O F

Common name	Scientific name	Method observed
Common Brushtail Possum	*Trichosurus vulpecula*	O
Common Ringtail Possum	*Pseudocheirus peregrinus*	O
Common Wombat	*Vombatus ursinus*	FB
Domesticated Cattle *	*Bos taurus*	O
Domesticated Dog *	*Canis lupus familiaris*	W
Eastern Coastal Free-tailed Bat [TS]	*Micronomus norfolkensis*	U
Eastern Freetail-bat	*Mormopterus ridei*	U
European Red Fox *	*Vulpes*	O
Red Deer *	*Cervus elaphus*	O
Gould's Wattled Bat	*Chalinolobus gouldii*	U
Horse *	*Equus caballus*	O
Large Forest Bat	*Vespadelus darlingtoni*	U [PR]
Long-eared Bat	*Nyctophilus sp.*	U [PR]
Little Forest Bat	*Vespadelus vulturnus*	U
Rabbit *	*Oryctolagus cuniculus*	O
Southern Myotis [TS]	*Myotis macropus*	U [PR]
White-striped Mastiff-bat	*Austronomus australis*	U
Reptiles		
Delicate Skink	*Lampropholis delicata*	O
Grass Skink	*Lampropholis guichenoti*	O
Amphibians		
Common Eastern Froglet	*Crinia signifera*	W
Peron's Tree Frog	*Litoria peronii*	W
Smooth Toadlet	*Uperoleia laevigata*	O W
Striped Marsh Frog	*Limnodynastes peronii*	W
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	O W
Whistling Tree Frog	*Litoria verreauxii*	W
Mollusc		
Brown Garden Snail *	*Cornu aspersum*	O

Note: * indicates introduced species
[TS] indicates threatened species
[MS] indicates Migratory species

All species listed are identified to a high level of certainty unless otherwise noted as:

[PR] indicates species identified to a 'probable' level of certainty – more likely than not
[PO] indicates species identified to a 'possible' level of certainty – low-moderate level of confidence

E - Nest/roost	H - Hair/feathers/skin	P - Scat	W - Heard call
F - Tracks/scratchings	K - Dead	Q - Camera	X - In scat
FB - Burrow	O - Observed	T - Trapped/netted	Y - Bone/teeth/shell
G - Crushed cones	OW - Obs & heard call	U - Anabat/ultrasound	Z - In raptor/owl pellet

3.3 Habitat results

3.3.1 Fauna habitat observations

The fauna habitats present within the site are identified within the following table.

Table 3.5 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate ✓	Steep ✓	Drop-offs ✓
Vegetation structure				
Closed Forest	Open Forest	Woodland ✓	Heath	Grassland ✓
Disturbance history				
Fire ✓	Under-scrubbing ✓	Cut and fill works ✓		
Tree clearing ✓	Grazing ✓			
Soil landscape				
DEPTH:	Deep ✓	Moderate ✓	Shallow	Skeletal
TYPE:	Clay ✓	Loam ✓	Sand ✓	Organic ✓
VALUE:	Surface foraging ✓	Sub-surface foraging ✓	Denning/burrowing ✓	
WATER RETENTION:	Well Drained ✓	Damp / Moist ✓	Water logged ✓	Swamp / Soak ✓
Rock habitat				
CAVES:	No caves recorded onsite			
CREVICES:	No crevices recorded onsite			
ESCARPMENTS:	No escarpments recorded onsite			
OUTCROPS:	No outcrops recorded onsite			
SCATTERED / ISOLATED:	High Surface Area Hides	Med. Surface Area Hides ✓	Low Surface Area Hides ✓	
Feed resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias	Melaleucas ✓	
	Banksias	Acacias ✓		
SEEDING TREES:	Allocasuarinas	Conifers		
WINTER FLOWERING EUCALYPTS:	C. maculata	E. crebra	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta	E. tereticornis ✓	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn	Winter ✓	Spring ✓	Summer ✓
OTHER:	Mistletoe ✓	Figs / Fruit	Sap / Manna ✓	Termites ✓
Foliage protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate ✓	Sparse ✓	
PLANT / SHRUB LAYER:	Dense	Moderate ✓	Sparse ✓	
GROUNDCOVERS:	Dense	Moderate ✓	Sparse ✓	
Hollows / logs				
TREE HOLLOWS:	Large ✓	Medium ✓	Small ✓	
TREE HOLLOW TYPES	Spouts / branch ✓	Trunk ✓	Broken Trunk ✓	Basal Cavities ✓	Stags ✓
GROUND HOLLOWS:	Large	Medium ✓	Small ✓	
Vegetation debris				
FALLEN TREES:	Large	Medium ✓	Small ✓	
FALLEN BRANCHES:	Large	Medium ✓	Small ✓	
LITTER:	Deep	Moderate ✓	Shallow ✓	
HUMUS:	Deep	Moderate ✓	Shallow ✓	

Drainage catchment						
WATER BODIES	Wetland(s)	Soak(s) ✓	Dam(s) ✓	Drainage line(s) ✓	Creek(s) ✓	River(s) ✓
RATE OF FLOW:	Still ✓		Slow ✓		Rapid	
CONSISTENCY:	Permanent ✓		Perennial ✓		Ephemeral ✓	
RUNOFF SOURCE:	Urban / Industrial	Parkland	Grazing ✓		Natural ✓	
RIPARIAN HABITAT:	High quality	Moderate quality ✓	Low quality ✓		Poor quality	
Artificial habitat						
STRUCTURES:	Sheds ✓		Infrastructure ✓		Equipment ✓	
SUB-SURFACE	No sub-surface artificial habitat recorded onsite					
FOREIGN MATERIALS:	Sheet ✓		Pile / refuse ✓			

3.3.2 Habitat tree data

Significant habitat trees observed within the development footprint / study area are tabulated below. Significant habitat trees are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10–30 cm) sized hollow. A tree may also sometimes be considered significant where evidence of use by threatened fauna is found, however no such trees have been additionally identified on this site to date.

Table 3.6 – Habitat tree data

Tree No	Significant Habitat tree	Scientific Name	Common Name	DBH (cm)	Height (m)	Spread (m)	Vigour (%)	Hollows & Other Habitat Features Recorded
HT21	SHT21	*E tereticornis*	Forest Red Gum	89	28	19	80	2x 5-10cm trunk hollows 2x 5-10cm branch spouts 1x 15-20cm trunk hollow fine scratches around the entrance
HT22	SHT22	*E tereticornis*	River Red Gum	143	29	16	75	1x 50-60cm trunk hollow 2 entrances
HT23	SHT23	E tereticornis	River Red Gum	145	32	19	75	1x 50-60cm trunk hollow 1x 50-60cm branch spout

Biodiversity Assessment 4

4.1 Previous surveys reviewed

The following regional vegetation mapping and reports were examined to identify the potential vegetation communities and other threatened biodiversity with potential to occur for assessment.

Vegetation mapping of the Cumberland Plain (NSW National Parks and Wildlife Service 2002) identifies the following communities within the study area (Figure 2.1):

- Alluvial Woodland
- Shale Sandstone Transition Forest (Low Sandstone Influence)
- Shale Sandstone Transition Forest (High Sandstone Influence)
- Moist Shale Woodland
- Shale Plains Woodland
- Shale Hills Woodland
- Riparian Forest

4.2 Flora

All species are listed in Table 3.1.

4.2.1 Local / Regional flora matters

The Liverpool Development Control Plan (DCP) 2008 and Local Environment Plan (LEP) 2008 do not list any regionally significant flora species.

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

BC Act – A search of the *Atlas of NSW Wildlife* (DPIE 2020) indicated a list of species that have been recorded within a 10 km radius of the study area. Those species are considered for suitable habitat and potential to occur in Table A1.1 (Appendix 1).

Based on the habitat assessment within Appendix 1, it is considered that the development footprint provides varying levels of potential habitat for the following state listed threatened flora species:

Table 4.1 – State listed threatened flora species with suitable habitat present

Scientific name	*BC Act*	Potential to occur
Eucalyptus benthamii	V	recorded outside of development footprint
Grevillea juniperina subsp. *juniperina*	V	low
Pimelea spicata	E1	unlikely

Note: Full habitat descriptions for these species are provided in Appendix 1.

One (1) state listed threatened flora species, *Eucalyptus benthamii,* was observed during survey(s) undertaken. In individuals of this specie were recoded outside the development footprint along the Nepean River and will not be impacted by the proposal. A detailed significance of impact assessment has been applied to this species within Appendix 2 in accordance with Section 7.3 of the *BC Act*. The test of significance for threatened flora species has concluded a non-significant impact.

Grevillea juniperina subsp*. juniperina* has low potential to occur on site but no individuals were observed during survey. We consider that this species is not present within the study area.

Pimelea spicata is unlikely to occur due to the marginal habitat from past and ongoing land management practices such as grazing and farming.

(b) Endangered flora populations (NSW)

There is one known endangered population within 10 km of the study area:

- *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas.

The study area contains potential habitat for *Marsdenia viridiflora* subsp. *viridiflora* specimens, however due to the highly disturbed condition of the vegetation present, it is not considered that this population has any potential to occur. No individuals were observed during surveys undertaken.

(c) Threatened ecological communities (NSW)

Two (2) threatened ecological communities (TECs) were observed:

- *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* – (RFEF) endangered
- *Cumberland Plain Woodland in the Sydney Basin Bioregion* – (CPW) critically endangered

These communities have been assessed in detail within Appendix 2.

(d) Endangered wetland communities

A number of wetland communities have been listed as TECs under the *BC Act*. We note that 'wetlands' are included in the definition of 'waterfront lands' in accordance with the *Water Management Act 2000* (*WM Act*) due to their inclusion in the definition of a 'lake' under the same Act. TECs that are considered to be an endangered protected wetland are as follows:

- Artesian springs ecological community
- Castlereagh Swamp Woodland Community
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions
- Coastal Upland Swamp in the Sydney Basin bioregion
- Coolibah–Black Box woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands bioregions
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- Kurri sand swamp woodland in the Sydney Basin Bioregion
- Lagunaria swamp forest on Lord Howe Island
- Maroota Sands swamp forest
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- The shorebird community occurring on the relict tidal delta sands at Taren Point
- Upland wetlands of the drainage divide of the New England Tableland Bioregion
- Wingecarribee Swamp

No endangered wetland communities were present within the development footprint and therefore a referral to NRAR is not required.

(e) Groundwater dependent ecosystems

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

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

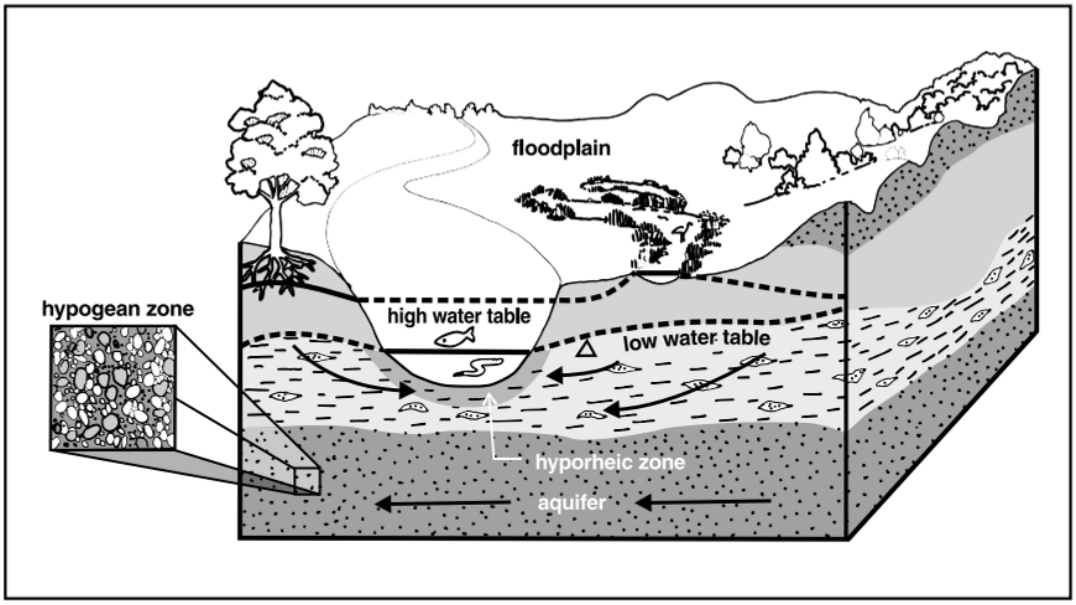


Figure 4.1 – Alluvial groundwater system discharging into a river

GDEs are therefore ecosystems which have their species composition and their natural ecological processes determined by groundwater (NSW State Groundwater Dependent Ecosystems Policy April 2002).

The RFEF vegetation (PCTs 835 and 1108) is a GDE as it is likely fed from an aquifer associated with the nearby Nepean River.

The proposed development will provide a 40 m wide buffer from the top of bank either side of Duncans Creek, and from the eastern bank of the Nepean River, which will provide protection for this vegetation community in order to retain, improve and manage it. The proposed bridge over Duncans Creek has been designed such that no impacts to native vegetation or hydrology will occur (see Section 5.1.1. for additional detail). The prepared VMP details additional protection and restoration actions for this vegetation.

(f) State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5. of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

The Coastal Management SEPP gives effect to the objectives of the *CM Act* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

An integrated and coordinated approach to land use planning is promoted by the new SEPP. It defines the four coastal management areas in the Act through detailed mapping and specifies assessment criteria that are tailored for each coastal management area. Councils and other consent authorities must apply these criteria when assessing proposals for development that fall within one or more of the mapped areas. The Coastal Management SEPP identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the *CM Act*.

The Coastal Management SEPP establishes the approval pathway for coastal protection works.

Wetlands on site or adjacent

The NSW DPIE *Coastal Wetlands and Littoral Rainforests Area Map* (http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=SEPP_CoastalManagement) identifies that there are no areas within the study area or nearby mapped as "coastal wetlands" or "proximity area for coastal wetlands" (refer to Figure 4.2).

There are no wetlands onsite.

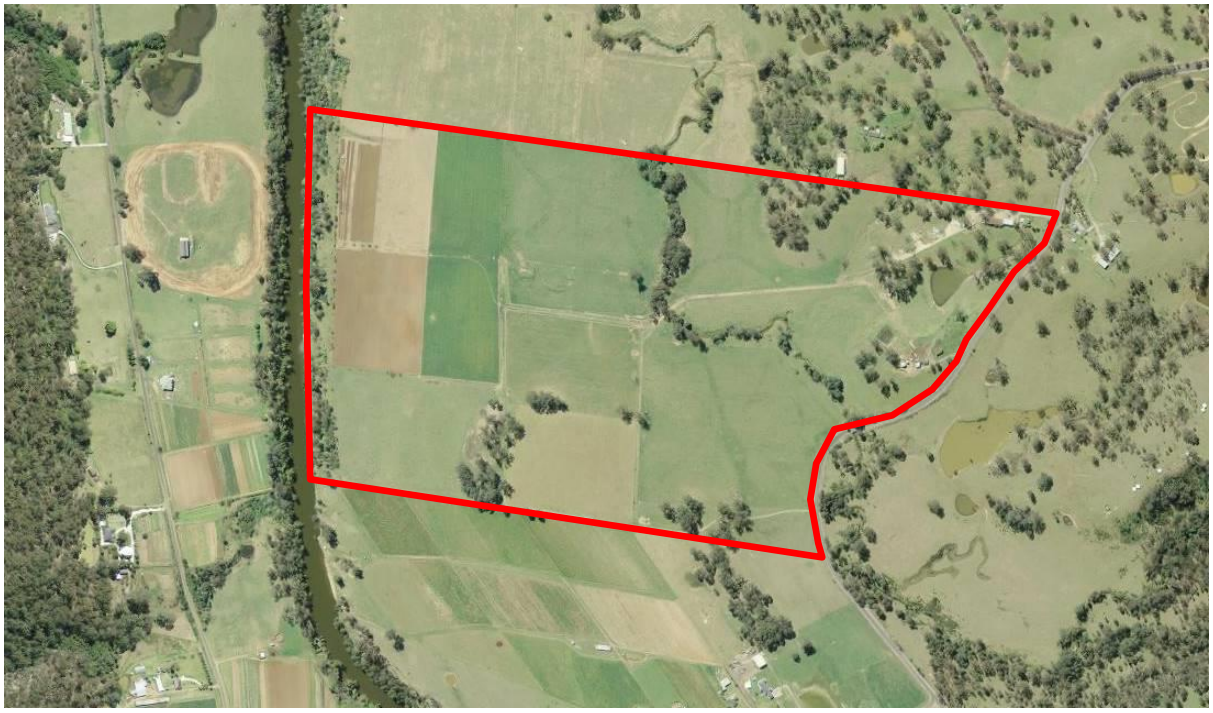


Figure 4.2 – Coastal wetlands area map

4.2.3 Matters of national environmental significance - flora

(a) Threatened flora species (national)

EPBC Act – A search of the *BioNet* (DPIE, 2020) and the EPBC Search Tool provided a list of nationally threatened fauna species previously recorded, or with considered potential habitat, within a 10 km radius of the development footprint. These species have been listed and considered for habitat potential based on proximity and year of records in Table A1.1 (Appendix 1).

Based on this, it is considered that the development footprint provides varying levels of potential habitat for the following nationally listed threatened flora species:

Table 4.2 – Nationally listed threatened flora species with suitable habitat present

Scientific name	*EPBC Act*	Potential to occur
Eucalyptus benthamii	V	recorded

Scientific name	*EPBC Act*	Potential to occur
Pimelea spicata	E	unlikely

One (1) nationally listed threatened flora species, *Eucalyptus benthamii,* was observed within the study area.

Eucalyptus benthamii

All recorded individuals of *E. benthamii* occur in the far western portions of the site adjacent to the Nepean River. These individuals will not be impacted by the proposal.

The prepared VMP identifies protection and conservation actions for *E. benthamii* on site.

(b) Threatened ecological communities (national)

Within the study area, PCT 849 and PCT 850 are potentially equivalent to the *EPBC*-listed critically endangered community (CEEC) *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* – (CPSW). In order to be classified as part of this TEC, the vegetation in question must meet key diagnostic and conditional criteria.

PCT 849 (Zone 3) does not meet the key diagnostic criteria as the understorey is not dominated by native graminoids and forbs. Only 7% of the understorey vegetation cover is provided by natives, whereas exotic species provide 55% cover.

PCT 850 (Zone 4) does meet the key diagnostic criteria as the vegetation present:

1. Occurs in the Sydney Basin IBRA bioregion, and Cumberland IBRA sub-region
2. Occurs on clay soils derived from Wianamatta Group geology
3. Upper tree layer of over 10% cover, and dominated by *E. tereticornis* and *E. moluccana*
4. The understorey is comprised primarily of perennial native graminoids and forbs, most of which are diagnostic for the listed TEC

PCT 850 vegetation must also meet the condition criteria. These have been assessed in the flow chart shown in Figure 4.3 using data from plots 4 and 6.

Some of the criteria relate to native perennial understorey cover as a % of the total. In Plot 4, the total perennial understorey (native and exotic) provides 42.4% cover. Native perennial understorey species provide 13.1% PFC, which equates to 30.9% of the total perennial understorey cover.

In plot 6, the total perennial understorey provides 69.5% cover. Native perennial understorey species provide 60.5% PFC, which equates to 87.1% of the total perennial understorey cover.

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

Q1 – Tree cover 10% or more? Both plots: Yes – Go to Q2. Tree cover was 31% in plot 4 and 23% in plot 6.
Q2 – Patch size 0.5 ha or more? Both plots: Yes – Go to Q3. Vegetation in Zone 4 is contiguous with a large patch of similar vegetation covering at least 17 ha.
Q3 – Perennial understorey is comprised of 50% or more in native species? Plot 4: No (30.9%) – Go to Q4. Plot 6: Yes (87.1%) – commensurate with *EPBC* listing

Q4 – Is the patch size 5 ha or more? Both plots: Yes – Go to Q5
Q5 - Perennial understorey is comprised of 30% or more in native species? Plot 4: Yes (30.9%) – commensurate with *EPBC* listing.

Based on this assessment and the data collected in plots 4 and 6, vegetation within PCT 850 is commensurate with the *EPBC*-listed TEC. Although the areas which contain these plots will not be impacted, they are representative of all vegetation within this vegetation zone (PCT 850). It is reasonable to conclude that all of PCT 850 is commensurate with the *EPBC*-listed TEC, including the areas impacted.

An impact of 0.23 ha on PCT 850 equivalent to this TEC is not considered significant.

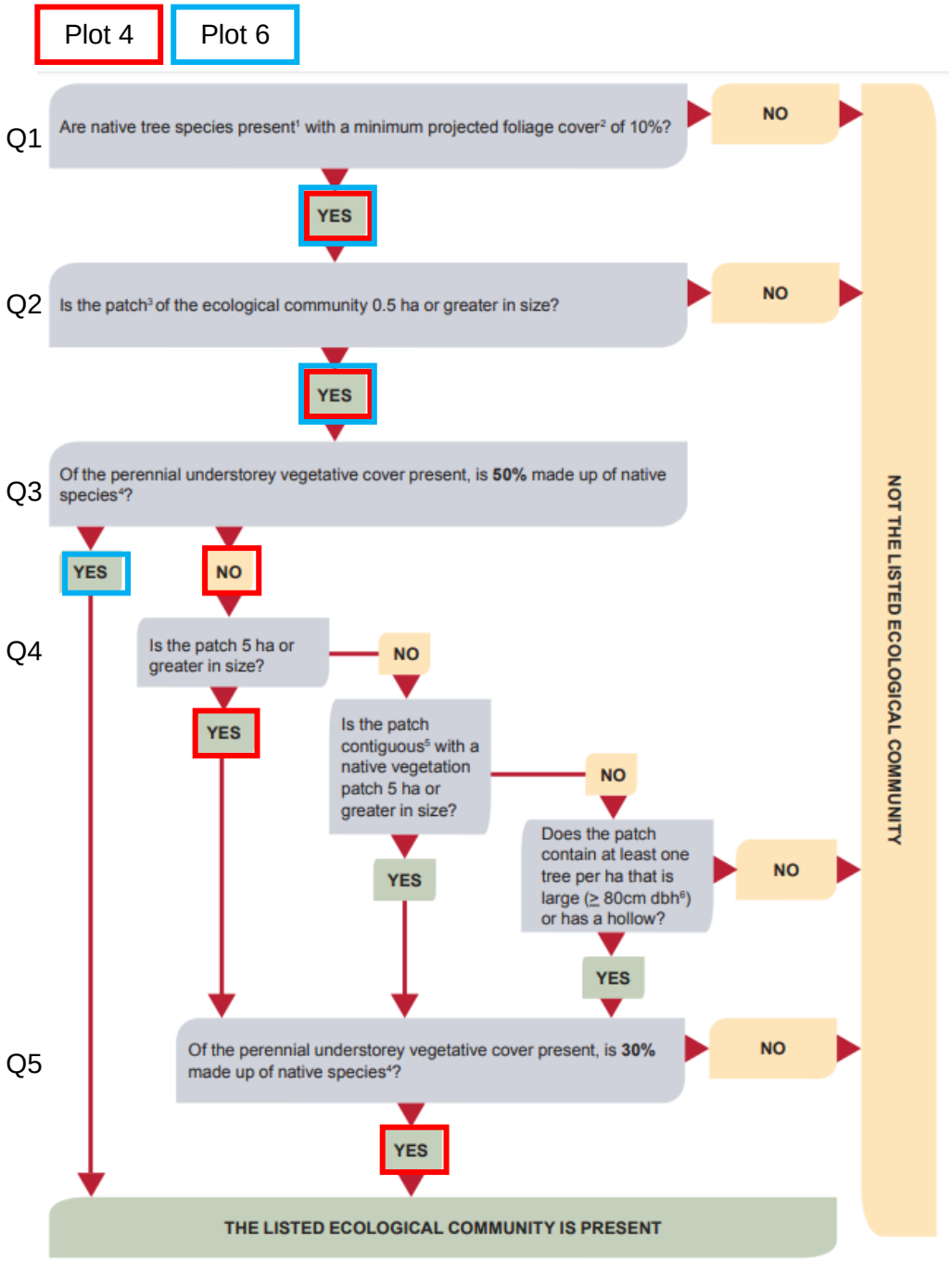


Figure 4.3 – Flowchart for identifying Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

4.3 Fauna

All fauna species recorded during surveys, key fauna habitat observations and habitat tree data are provided in Section 3.

4.3.1 Key fauna habitat

Most notable habitat features for threatened fauna species considered with most potential to occur (see Sections 4.3.3 & 4.3.4) include:

- Large hollows (30+cm), medium hollow (10-30cm) and small hollows (<10cm)
- Ephemeral drainages
- Seasonal flowering opportunities for nectivorous species.
- Winter flowering trees
- Open water large adjacent river, smaller dams and wetland habitat
- Fringing riparian vegetation providing canopy connectivity along much of the reaches

The available size range and quality of hollows were noted during site visits; however a detailed habitat tree survey has not been undertaken.

Data on significant habitat trees was however collected and identified by GPS; locations are depicted on Figure 2.2 and data is provided in Table 3.6. Significant habitat trees are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10-30cm) sized hollow. A tree may also be considered significant where evidence of use by select threatened fauna is found. None of the latter were however identified.

Hollows were observed to be utilised by a large communal flock of Little Corellas, Tree Martins and Striated Pardalotes. Other hollow-dependent fauna recorded included Australian Owlet-nightjar, Australian Wood Duck, Eastern Rosella, Galah, Grey Shrike-thrush, Grey Teal, Laughing Kookaburra, Long-billed Corella, Pacific Black Duck, Rainbow Lorikeet, Red-rumped Parrot, Sulphur Crested Cockatoo, Yellow-tailed Black-Cockatoo, Common Brushtail Possum, Common Ringtail Possum, Eastern Coastal Free-tailed Bat, Eastern Freetail-bat, Gould's Wattled Bat, Large Forest Bat, Long-eared Bat, Little Forest Bat, Southern Myotis, White-striped Mastiff-bat, Peron's Tree Frog and Whistling Tree Frog. Of these the Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Southern Myotis (*Myotis macropus*) are state listed threatened species and roosting or breeding may occur within the development footprints.

Removal of trees and vegetation has been avoided where possible for this proposal. A detailed hollow-bearing tree survey is required within the development footprints. Any hollows requiring removal should have a strict hollow-removal process applied to recover and relocate any resident fauna. Where these are threatened or where hollows are found of high quality, these should be sectionally cut and relocated into retained trees within the landscape under the guidance of a fauna ecologist. This process will effectively reduce potential impacts on hollow threatened species.

No large hollows suitable for threatened owls were recorded present within the study area

4.3.2 Local fauna matters

Fauna species recorded present during survey and listed as a regionally significant species within the *Native Fauna of Western Sydney - Urban Bushland Biodiversity Survey* (NPWS

1997) include the Wedge-tailed Eagle, White-bellied Sea Eagle, Bar-shouldered Dove, Smooth Toadlet and Common Wombat.

No large raptor nests were observed within the study area. Based on survey observations the White-bellied Sea Eagle may be nesting further north along the Nepean River. As it could not be seen from the site side of the river, such nest if nearby is sufficiently setback from the proposal.

Bar-shouldered Dove was recorded in vegetation along the Nepean River that will be retained by the proposal, such that if this area is being utilised for nesting, as expected, this habitat will continue. There will be higher potential for human presence and disruption but also an increased habitat suitability through restoration. This restoration should be staged to permit continued structure for birds in old areas whilst other newly restored areas recover.

4.3.3 State legislative fauna matters

(a) Threatened fauna species (NSW)

BC Act – A search of the *Atlas of NSW Wildlife* (DPIE, 2020) provided a list of threatened fauna species previously recorded within a 10 km radius of the development footprint. These species are listed in Table A1.2 (Appendix 1) and are considered for potential habitat within the development footprint.

Based on the habitat assessment within Appendix 1, it is considered that the development footprint provides varying levels of potential habitat for the following state listed threatened fauna species:

Table 4.3 – State listed threatened fauna species with suitable habitat present

Common name	*BC Act*	Potential to occur
White-bellied Sea Eagle	V	Recorded
Eastern Coastal Free-tailed Bat	V	Recorded
Southern Myotis	V	Recorded
White-throated Needletail	-	✓
Little Eagle	V	✓
Square-tailed Kite	V	✓
Gang-gang Cockatoo	V	✓
Little Lorikeet	V	✓
Swift Parrot	E	✓
Barking Owl	V	✓
Powerful Owl	V	✓
Regent Honeyeater	E4A	✓
Varied Sittella	V	✓
Dusky Woodswallow	V	✓
Grey-headed Flying-fox	V	✓
Yellow-bellied Sheathtail-bat	V	✓
Large-eared Pied Bat	V	✓
Eastern False Pipistrelle	V	✓
Greater Broad-nosed Bat	V	✓
Little Bent-winged Bat	V	✓
Large Bent-winged Bat	V	✓

Common name	*BC Act*	Potential to occur
Scarlet Robin	V	Low
Cumberland Plain Land Snail	E	Low
Macquarie Perch	V (*FM Act*)	Low
Masked Owl	V	Unlikely
Brown Treecreeper	V	Unlikely
Black-chinned Honeyeater	V	Unlikely
Hooded Robin	V	Unlikely
Diamond Firetail	V	Unlikely

Note: Full habitat descriptions for these species are provided in Appendix 1.

Three (3) state listed threatened fauna species – White-bellied Sea Eagle (*Haliaeetus leucogaster*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) and Southern Myotis (*Myotis macropus*) – were recorded within the development footprint during surveys. A detailed significance of impact assessment has been applied to these species within Appendix 2 in accordance with Section 7.3 of the *BC Act*. Provided a detailed hollow removal process is undertaken to effectively recover hollow-dependent species, the test of significance for threatened fauna species has concluded a not significant impact.

FM Act – A review of the *EPBC Act Protected Matters Report* identified the presence of two (2) threatened aquatic species or habitat for these species within a 10km radius of the development footprint. These species are also listed under the *FM Act* and include the Macquarie Perch (*Macquaria australasica*) and Australian Greyling (*Prototroctes maraena*). It is considered that the adjacent Nepean River provides potential habitat for the Macquarie Perch and as such this species has been incorporated into the seven-part test within Appendix 2.

It is considered that there will be no detrimental effect on water quality, water quantity or any direct impacts upon threatened fish species habitat within the Nepean River from the proposed action. The portion of Nepean River in not an area identified as critical habitat under the *FM Act*. Therefore, it is concluded that there will be no significant impact on threatened fish species listed under the *FM Act.*

(b) Endangered fauna populations (NSW)

There are no endangered fauna populations identified specifically to the Liverpool LGA; however, the site does fall within the Sydney Metropolitan Catchment Management Authority area. An endangered population of White-fronted Chat (*Epthianura albifrons*) is identified to this area however this is made up of two known isolated sub-populations; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. The study area does not provide any suitable habitat for this species.

(c) SEPP (Koala Habitat Protection) 2019

State Environmental Planning Policy (SEPP) Koala Habitat Protection 2019 now replaces SEPP 44 – Koala Habitat Protection. The following considerations apply to the subject lot under the new policy.

a) The development is a Part 4 development under the *EP&A Act*;
b) No Koala Plan of Management exists for the land or lands within the City of Liverpool LGA;

c) The Liverpool LGA is listed in Schedule 1 of the SEPP;
d) The lot size and together with adjacent land under the same ownership is greater than 1 hectare;
e) The proposal involves clearing of 0.65 ha native vegetation therefore the proposed development impacts mapped Koala habitat and the development automatically becomes Tier 2 development;

Based on the outcomes above, Appendix C of the Koala Habitat Protection Guideline needs to be addressed to determine if the site forms Core Koala Habitat under the definitions of the SEPP. This in summary includes:

Part A – Presence of Highly Suitable Habitat – Involves vegetated mapping of Plant Community Types (PCTs) and determination of "highly suitable Koala habitat" for each PCT based on the presence of >15% of the regionally relevant Koala use trees listed in Schedule 2. If this is determined then the SEPP process proceeds to Part B.

Part B i) – Koala Presence – This involves a field-based assessment of the presence of Koala to specific criteria by a demonstrated experienced person. If Koala is recorded then the Core Koala Habitat is concluded.

Part B ii) Koala Records – in addition to site survey, Core Koala Habitat is concluded where any Koala records spanning 18 years (3 Koala generations) within 2.5 km of the site (east of the great divide) or 5 km (remaining western LGAs with KMAs noted in Schedule 1) are present, reflecting median Koala home ranges. The suitably qualified and experienced person should consider movements also based on an examination of the broader landscape.

If Core Koala Habitat is concluded a Koala Assessment Report will be required. This will need to be prepared by a demonstrated experienced person and will need to outline details how the proposed development avoids, minimises and compensates for impacts to Koala habitat following the Koala Habitat Protection Guideline. Note: A Koala Assessment Report is accepting of Koalas in the locality and will therefore likely incur further development criteria and design.

Application of Appendix C criteria

Part A - Presence of Highly Suitable Habitat

Four (4) eucalypt Koala use trees (as identified under Schedule 2 of the SEPP) were recorded within the study area by TBE. These trees are listed in Table 4.4.

Table 4.4 – Koala use trees (SEPP 2019) in the study area

Family	Scientific name	Common name
TREES		
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum
Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Myrtaceae	*Eucalyptus moluccana*	Grey Box
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum

Two additional eucalypt trees recorded Blue Box (*Eucalyptus baueriana*) and River Peppermint (*Eucalyptus elata*) are not recognised Koala use trees under the Central Coast Koala Management Area but are within other KMAs.

Species assemblage in the impacted PCTs include:

- PCT 1108 - No Koala use trees present.
- PCT 835 > 15% Koala use trees present in the PCT estimated at 100% *Eucalyptus tereticornis* in the SW patch and 80% in other patches
- PCT 849 > 15% Koala use trees present in the PCT estimated at 100% *Eucalyptus tereticornis* & *Eucalyptus moluccana*
- PCT 850 > 15% Koala use trees present in the PCT estimated at 100% *Eucalyptus tereticornis* & *Eucalyptus moluccana*

Therefore, vegetation within the study area is considered to be “highly suitable Koala habitat” in accordance with the SEPP. Proceeding to Part B.

Part B i) - Koala Presence

Koala survey was undertaken within the study area that did not involve the full rigorous criteria outlined by the SEPP given the fragmented nature of the site. The best patches of habitat were selected and one SAT and two Rapid-SATs were undertaken. Due to the separated nature of vegetation the distances between these were greater than the 250 m requirement. Refer to Section 2.3 for full survey effort description and Figure 2.2 for locations.

No Koala activity was recorded.

Part B i) - Koala Records

There is only one (1) record of Koala within the specified 2.5km radius from the study area, this is located 2.15 to the SSW from 2016 (refer to Figure 4.4 for location). The details of this record are provided in Table 4.5 as required. Other recent records beyond the 2.5 km threshold occur to the west along the fringes of extensive forest habitat across the Warragamba Dam catchment area.

As stated within the Koala Management Protection Guideline - Appendix C - Part B ii), records within this distance should be considered after careful consideration of the broader landscape. With this in mind, the single record is located on the other side of the Nepean River which may be regarded as a considerable barrier to movement, particularly given that no records are otherwise known on the eastern side of the river within 5 km. This combined with the distance of the record and the fragmented nature of other habitat on the eastern side of the river between the recorded location and the study area, is sufficient to conclude that the study area is not likely to support Core Koala Habitat, based on records.

A Koala Assessment Report and associated development design criteria will therefore not be required.

It is also noted that the proposal can mitigate the loss of Koala use tree species by replacement of these with plantings with the riparian and retained vegetated landscape under the proposed VMP. Whilst access may be impeded by roads, these will have slow speed restrictions and therefore access across the site and availability of feed trees and habitat patches will otherwise remain quite consistent in the post development landscape.

Figure 4.4 – Local Koala records

Table 4.5 – Details of Koala record 2.15km to the SSW

FID	19138
Dataset Name	OEH Data from Scientific Licences dataset
Sighting Key	SIXRI1299548
Species Code	1162
NSW Status	V,P
Commonwealth Status	V
Profile ID	10616
Date First	27/04/2016
Date Last	27/04/2016
Number Individuals	1
Source Code	4
Observation	O
Status	Valid and accepted without modification
Location Key	LIXRI0109879
Description	590 Bents basin rd, Wallacia
Latitude_G	-33.920255
Longitude_	150.630286
Zone	56
Easting	280934
Northing	6244157
Accuracy	200
LocationNo	Koala scratch in eucalyptus punctata confirmed by OEH Illawarra

4.3.4 Matters of national environmental significance - fauna

(a) Threatened fauna species (National)

EPBC Act – A search of the *BioNet* (DPIE, 2020) and the EPBC Search Tool provided a list of nationally threatened fauna species previously recorded, or with considered potential habitat, within a 10 km radius of the development footprint. These species have been listed and considered for habitat potential based on proximity and year of records in Table A1.2 (Appendix 1).

Based on this, it is considered that the development footprint provides varying levels of potential habitat for the following nationally listed threatened fauna species:

Table 4.6 – Nationally listed threatened fauna species with suitable habitat present

Common name	*EPBC Act*	Potential to occur
White-throated Needletail	V	✓
Swift Parrot	E	✓
Regent Honeyeater	CE	✓
Grey-headed Flying-fox	V	✓
Large-eared Pied Bat	V	✓
Macquarie Perch	E	low

No nationally listed threatened fauna species, were recorded within the study area during surveys undertaken. The Significant Impact Criteria for species listed under the *EPBC Act* 1999 (Appendix 3) was reviewed to assess the potential for a significant impact on the above listed threatened fauna as a result of the proposed subdivision layout. As the development footprint does not contain any likely roosting or subsequent breeding habitat for these species, and foraging habitat will remain well represented in the locality, it is concluded that there will not be any significant impact on this species, or other nationally listed threatened fauna with potential to occur.

(b) Protected migratory species (National)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10 km radius of the development footprint. The habitat potential of migratory species that have not been considered in the threatened species habitat assessment are considered in Table A1.3 (Appendix 1).

No nationally protected migratory bird species were recorded present during the survey.

The impact assessment for nationally protected migratory species with potential to occur has concluded a not significant impact.

Impact Assessment 5

5.1 BOS thresholds

The BOS includes two (2) elements to the threshold test – an area trigger and a Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the Biodiversity Offset Scheme applies to the proposed clearing.

5.1.1 Biodiversity Values Land

The study area is located on lands mapped as Biodiversity Values Land (refer to Figure 5.1). The proposal completely avoids these mapped lands, except for the crossing over Duncans Creek. Previously proposed piped stormwater connections to Duncans Creek and the Nepean River are to be revised to be overland to avoid impacts to mapped biodiversity values areas.

Under Section 7.1, item 1) b) of the *BC Reg.,* impacts within Biodiversity Values Land only trigger the BOS if "*the clearing of native vegetation, or other action prescribed by clause 6.1"* occurs on land included on the Biodiversity Values Map.

In this instance we have liaised with the client to ensure that the bridge crossing will be of adequate height and design to avoid impact to native vegetation adjacent to and below the bridge. The bridge must pass between the canopies of two large eucalypts (see Figure 2.2) and must be no more than 10 m wide. The current proposal complies with these specifications.

The bridge support pylons will be located outside of the mapped Biodiversity Values Land, thus avoiding any additional impacts as prescribed in clause 6.1 of the *BC Reg.* Prescribed impact are detailed in section 5.3.1 of this BAR, and there are no expected prescribed impacts associated with the bridge crossing.

As there will be no clearing of native vegetation or prescribed impacts due to the bridge crossing, based on these assumptions, an offset is not required as an outcome of this threshold test.

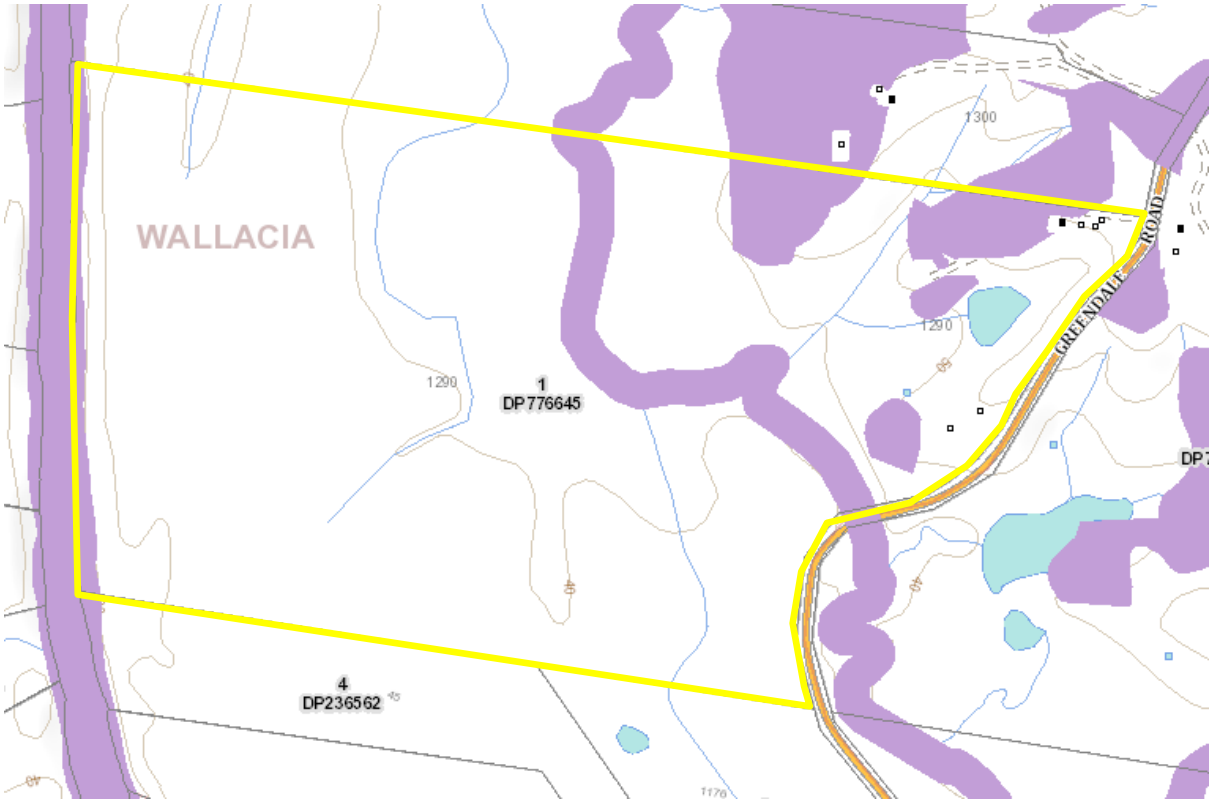


Figure 5.1 – Biodiversity Land Map (purple) relative to the study area (yellow)

(Source: https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BosetMap)

5.1.2 Area clearing threshold

The area threshold varies depending on the minimum lot size (shown in the Lot Size Maps made under the relevant Local Environmental Plan (LEP)), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP).

The area threshold applies to all proposed native vegetation clearing associated with a development proposal – for example in the case of a subdivision; all future clearing across the lots subject to the subdivision, must be considered. Thresholds outlined under the BOS are outlined in the table below.

Table 5.1 identifies that the site has a minimum lot size of 40 ha, and the clearing area threshold for which the BOS applies is 1 ha. Based on the current site plan (Figure 1.4), the current proposed clearing of 0.65 ha will exceed this threshold and offsetting will be required. We advise that retaining the patch of vegetation in the north east of the study area will reduce impacts below the threshold and avoid offsetting. Failing this, a Biodiversity Credit Offset Assessment will be required to be undertaken.

Table 5.1 – BOS entry threshold report

Date of Calculation	21/08/2020 9:50 AM		**BDAR Required***
Total Digitised Area	43.82	ha	
Minimum Lot Size Method	LEP		
Minimum Lot Size	40	ha	
Area Clearing Threshold	1	ha	
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)?	no		no
Date of the 90 day Expiry	N/A		

The Development proposal does not exceed the nominated clearing thresholds therefore offsetting is not required as an outcome of this test.

5.1.3 Test of Significance

A detailed test of significance has been applied to recorded *Eucalyptus benthamii,* Large Bent-winged Bat and River Flat Eucalypt Forest within Appendix 2 in accordance with Section 7.3 of the *BC Act*. The test of significance for threatened flora species has concluded a not significant impact.

Generally, an impact on a CEEC of over 0.5 ha is considered a significant impact. Although with the revegetation on site there is a total net gain in Cumberland Plain Woodland. As this is a mitigation measure and is not considered as an avoidance of impact. We advise that the far north-eastern patch of PCT850 CPW be retained to avoid a significant impact.

5.2 Avoidance actions

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

- Development has been located taking advantage of the existing cleared landscape. The initial development proposal is shown on Figure 1.3 and resulted in the total estimated impact of 4.166 ha, including 4.13 ha of TEC vegetation. Following the identification of these constraints the proposal has been refined to reduce the total impacts to 0.65 ha, including 1.09 ha of TEC vegetation. Refer to Figure 1.4 for the current proposed layout.
- The proposed bridge crossing over Duncans Creek has been designed and positioned to avoid impact to native vegetation and hydrology within the Biodiversity Values Lands (see Section 5.1.1. for details).
- Previously proposed piped stormwater connections to Duncans Creek and the Nepean River are to be revised to be overland to avoid impacts to mapped biodiversity values areas.
- The previous proposed layout also impacts on three 1st order streams and one 2nd order stream in the north-eastern portions of the site. The current proposal has been reconfigured to avoid the complete impact of three of these four streams. Burial plots will now impact on one 1st order stream and its associated dam, and the others mentioned will now only have vehicle crossing locations.

- Existing agricultural and livestock use of the site will be removed reducing potential for excess nutrient inputs and future weed occurrences in retained vegetation. Existing fencing along the complete northern and southern site boundary will be maintained to exclude stock from adjacent properties including farmed deer immediately to the north.
- A VMP has been prepared for the study area that identifies actions to improve vegetation integrity for the remaining portions, particularly along the Nepean River and the internal Duncans Creek. This will also focus on feral pest management.

Table 5.2 – Comparison of impacts (previous & current)

PCT		Area (ha)	Impacts (ha)	
			Previous	Current
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	2.54	0.81	0.16
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	0.63	0.45	0.26
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	2.87	2.87	0.23
1108	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	1.82	0	0
	Planted native vegetation	0.036	0.036	0
	TOTAL	**7.86 ha**	4.166	0.65

5.3 Potential ecological impacts

The direct, indirect and cumulative ecological impacts have been considered in respect to recorded biodiversity, threatening processes and extent of impact as a result of the proposed works:

5.3.1 BC Reg Prescribed impacts

The following potential impacts on biodiversity values as a result of the proposal are prescribed (subject to subclause (2) of the *BC Reg.*) as biodiversity impacts to be assessed under the biodiversity offsets scheme:

Human made structures - *The assessment of the impacts of development on the habitat of threatened species or ecological communities associated with human made structures must:*

(a) Identify the human made structures with potential to be habitat for threatened species or ecological communities

Response: The existing structures (houses and sheds) to be demolished by the proposal may have potential for microbat roosting use. Both recorded threatened microbats are known to roost in such man-made structures and both of these bats were recorded at the dam near to the old houses in the north-eastern extent of the site.

(b) Identify the species and ecological communities likely to use the habitat

Response: The threatened Southern Myotis (*Myotis macropus*) and Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) were recorded foraging over the dam in the north-eastern portions of the site, but have not been recorded utilising the adjacent man-made

structures. Having said this target survey to identify use of these buildings has not been undertaken.

(c) Describe the nature, extent and duration of short and long-term impacts

Response: Removal of structures has potential to remove temporary roosting opportunity. These structures would not be expected to be the only or significant roosting locations in the site or locality. Removal of these structures, if being utilised for roosting, may result in behavioural changes to the local colony. No long-term impacts are noteworthy.

(d) Describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the habitat to these species or ecological communities

Response: The importance of man-made structures to these two microbat species in the bioregion is expected to be undocumented.

(e) Predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.

Response: There are no expected notable consequences of the impacts for the local and bioregional persistence of the two threatened microbats considered.

Water quality - *The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development) must:*

(a) Identify water bodies with potential to be habitat for threatened species or threatened ecological communities that are likely to be impacted by the proposal

Response: The large dam located in the north-eastern portion of the study area will be removed by the proposal.

(b) Identify the threatened species and threatened ecological communities likely to use the habitat

Response: The threatened Southern Myotis (*Myotis macropus*) and Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) were recorded foraging over the dam during survey.

(c) Identify hydrological processes that sustain threatened species or threatened ecological communities and the species and communities that are dependent on them

Response: The two abovementioned threatened microbat species periodically utilise the constructed dam for foraging purposes.

(d) Describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the water body or hydrological process to these species or ecological communities

Response: The importance of man-made dams to these two microbat species in the bioregion is expected to be undocumented.

(e) Describe the nature, extent and duration of known short and long-term impacts on water bodies and hydrological processes

Response: The dam will be permanently removed.

(f) Describe the nature, extent and duration of short and long-term impacts on water quality

Response: The dam will be permanently removed.

(g) Predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information Assessment of impacts 39

Response: Removal of the dam will remove periodic foraging opportunity. This dam would not be expected to be a significant foraging resource in the site or locality. Removal will result in minor foraging behavioural changes for the local colonies.

(h) Predict the nature, extent and duration of short and long-term impacts on the habitat and life cycle of species using the natural features of any water dependent plant community

Response: No water dependent plant community has been recorded proximate to the dam.

(i) Justify predictions of impact on any water dependent plant communities, with appropriate modelling and with reference to relevant literature and other published sources of information

Response: No water dependent plant community has been recorded proximate to the dam.

(j) Predict the cumulative impacts of the project together with existing mining operations mining underneath the same water dependent plant communities

Response: Numerous other similar dams will remain in the locality. No mining operations are associated with the site or locality.

(k) Based on predictions of impacts on water dependant plant communities and the species they support, calculate the maximum predicted offset liability in accordance with the Upland Swamp Policy

Response: Not considered applicable.

(l) Justify any prediction of 'nil' or 'negligible' environmental consequences for any impact on water dependent plant communities and the species they support.

Response: Not considered applicable.

5.3.2 Direct impacts

The other direct impacts of the proposal within the development footprint are considered as:

- 0.16 ha of PCT 835 (RFEF)
- 0.26 ha of PCT 849 (CPW)
- 0.23 ha of PCT 850 (CPW)
- Removal of the large north-eastern dam

- Subsequent removal of threatened fauna species foraging habitat including open water foraging by Southern Myotis and Eastern Coastal Free-tailed Bat
- Potential removal of hollows suitable for roosting and potential breeding by recorded threatened microbat species Southern Myotis and Eastern Coastal Free-tailed Bat
- Removal of man-made structure (houses and sheds) that have potential roosting opportunity for the recorded Southern Myotis and Eastern Coastal Free-tailed Bat
- Removal of dead trees for perching use by recorded White-bellied Sea Eagle

5.3.3 Indirect impacts

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into retained vegetation
- Increased erosion and sediment movement from construction activities and earthworks
- Very minor reduction of cross-site connectivity for birds and arboreal mammals
- Increases and alteration to water runoff, pollutants and nutrients

5.3.4 Cumulative impacts

The potential cumulative impacts (combined results of past, current and future activities) of the proposal are considered as:

- Cumulative loss of CPW vegetation
- Cumulative loss of RFEF vegetation
- Cumulative loss of native vegetation
- Cumulative loss of open water foraging habitat for Southern Myotis

5.3.5 Serious & Irreversible Impacts (SAIIs)

An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community most at risk of extinction. Threatened species and communities that are potential for serious and irreversible impacts are outlined in Appendix 2 of *Guidance to assist a decision-maker to determine a serious and irreversible impact* (DPIE 2017). The principles for determining serious and irreversible impacts are set out under Section 6.7.2 of the *BC Reg*.

Candidate SAII entities recorded or with potential to occur within the study area include:

Table 5.3 – Candidate SAII species

Species / TEC (Scientific Name)	Species (Common Name)	*BC Act*	Potential to occur
Cumberland Plain Woodland		CE	recorded
Anthochaera phrygia	Regent honeyeater	CE	✓
Lathamus discolor	Swift parrot	E	✓
Miniopterus schreibersii subsp. oceanensis	Large Bent-winged Bat	V	✓
Chalinolobus dwyeri	Large-eared pied-bat	V	✓
Miniopterus australis	Little Bent-winged Bat	V	✓

As the BOS is not triggered, an additional assessment of SAII entities is not required.

5.4 Vegetation connectivity

The study area is situated on the Nepean River which runs the western edge of the site and is nestled amongst agricultural parcels of land. This river acts as a natural barrier for terrestrial species to move to and from the west. The riparian vegetation is quite extensive beyond site heading north and south on the eastern side of the river. The vegetation within the study area consists predominantly of grazing pastures containing few remnant patches of woodland trees. Small strips of riparian vegetation are also present through the site following Duncan creek which runs diagonally from the south east to north through the centre of the site.

The remnant woodland on site comprises of scattered trees with a consistently maintained understory for agricultural purposes. This vegetation structure extends beyond the site throughout the local landscape. This provides connective values for aerial fauna such as woodland birds and microchiropteran bats to move, forage and potentially breed throughout the landscape. A number of suitable hollows recorded within the site provide potential roosting opportunities for the recorded Eastern-coastal Free-tailed Bat and Southern Myotis.

Potential breeding opportunities are possible for raptor birds such as the recorded White-bellied Sea-eagle which was recorded flying over the site across a number of separate days. The individual is believed to be nesting just north of the site along where activity was prevalent. The family will utilise the site for foraging particularly along the river system.

The study area contains vegetation which contributes to connectivity to the local landscape however, only a small portion of this is likely to be removed as part of the development. Although the development will likely limit the woodland onsite, connectivity will still be reflected in the post development landscape. The study areas contribution to local connectivity is shown in Figure 5.2.

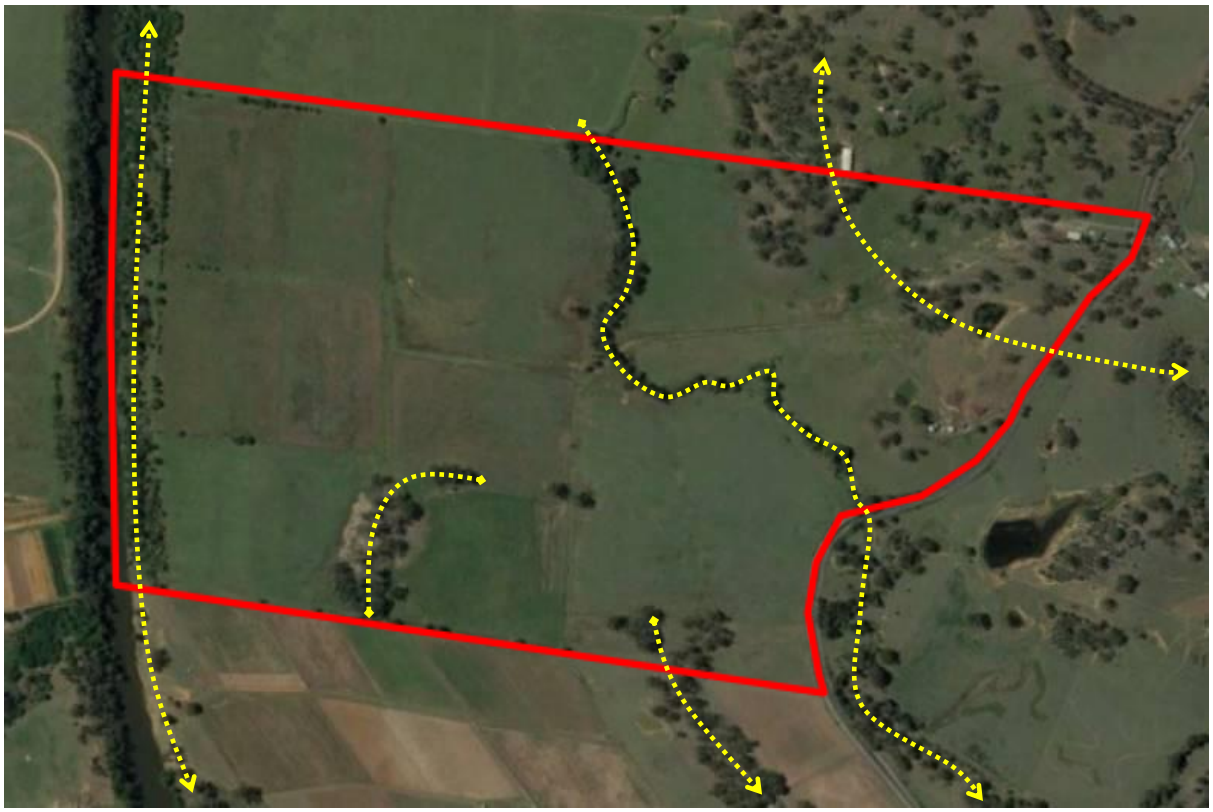


Figure 5.2 – Local connectivity

Conclusion 6

Travers bushfire & ecology has been engaged to prepare a Biodiversity Assessment Report (BAR) for a proposed cemetery at 1290 Greendale Road, Wallacia.

Ecological survey and assessment have been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Biodiversity Conservation Act 2016*, the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

6.1 Legislative compliance

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *BC Act*, Three (3) threatened fauna species White-bellied Sea Eagle (*Haliaeetus leucogaster*), Southern Myotis (*Myotis macropus*), and Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis)*, no threatened flora species, and two (2) threatened ecological communities (TECs), *Cumberland Plain Woodland* (CPW) and *Riverflat Eucalypt Forest* (RFEF), were recorded within the development footprint.

The assessment of significance test in accordance with Section 7.3 of the *BC Act* (Appendix 2) concluded that the proposal will not have a significant effect on CPW vegetation or other threatened biodiversity.

Based on the current proposed clearing, offsetting under the Biodiversity Offsets Scheme (BOS) is not required as:

1. the proposed clearing of vegetation is less than the area threshold of 1 ha, and
2. clearing of native vegetation has been avoided within the mapped Biodiversity Values area.
3. the proposal will not cause a Significant Impact on threatened biodiversity, as assessed in Appendix 2.

In respect of matters required to be considered under the *EPBC Act*, no threatened fauna species, no protected migratory bird species, no threatened flora species and one (1) threatened ecological community *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* listed under this Act were recorded within the development footprint.

In respect of matters relative to the *Fisheries Management Act 1994*, no suitable habitat for threatened marine or aquatic species was observed within the development footprint and there are no matters requiring further consideration under this Act.

6.2 Mitigation measures

The following mitigation measures are recommended to minimise or ameliorate the above potential ecological impacts, address threatening processes and to guide a more positive ecological outcome for threatened species and their associated habitats.

- Prepare a Vegetation Management Plan to manage avoidance and mitigation actions for the proposal:

  (a) Retained vegetation along the Nepean River is to be fully restored, with targeted weed control and revegetation, to achieve a fully-structured community. Existing *Eucalyptus benthamii* individuals are to be protected and additional seedlings are to be grown and planted to encourage the recovery of this species.
  (b) Retained vegetation elsewhere on the site is also to be fully restored, with targeted weed control and revegetation, to achieve a fully-structured community commensurate with CPW or RFEF according to the position on site.
  (c) An area of CPW and RFEF is to revegetated to offset impacted vegetation at a ratio of at least 2:1. The VMP provides for greater than this ratio.
  (d) Landscaping within the property is to use locally occurring native species commensurate the existing TECs on site where in close proximity to existing TECs. A detailed planting list is provided in the VMP.
  (e) The regionally significant Bar-shouldered Dove was recorded on site in vegetation along the Nepean River and is expected to be utilising this habitat for breeding. This restoration should therefore be staged to permit continued structure for birds in old areas whilst other newly restored areas recover, or existing cleared patches restored first.
  (f) Hollow relocation and nest box installation.
  (g) Priority areas for sediment and erosion control.
  (h) Undertake feral pest management, also including control of rabbits, avian pests, and any other miscellaneous species as required.
  (i) Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal herbicides.
  (j) Requirements prior to and during construction, including:
    - Fencing - Where they adjoin the development areas, the boundaries of the conservation areas shall be clearly marked out on-site to ensure their protection. All areas of retained natural vegetation shall be protected by fencing, prior to construction, to ensure that these areas are not damaged during the construction phase
    - Project ecologist - Construction activities will be intermittently supervised on-site and monitored by a project ecologist to ensure that the recommendations of this report are implemented. All staff involved with the development shall undergo an induction and training program to reinforce the ecological and environmental objectives of the development
    - Undertake water quality testing of Duncans Creek to monitor water quality pre-, during, and post-development

- Site wide hollow-bearing tree survey is to be undertaken within the development areas requiring tree removal to identify all potential hollow cavities for wildlife. Any of these that show signs of use based on their quality should be stag-watched prior to clearing. The management of the hollows is to be directed by an appointed Project Ecologist.

- Hollow-bearing trees are to be clearly marked prior to clearing. This is so that potential habitat for hollow-dependent species can be identified and quantified. Where possible these trees should be retained in-situ.

- The felling of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for threatened species. Hollows of high quality or with fauna recorded residing within should be dismantled for relocation and all hollows should be inspected for occupation, signs of previous activity and potential for reuse.

- Subsequent hollows of retention value are to be relocated to nearby conservation areas. If these are placed as on ground habitat and are not reattached to a new recipient tree then they are to be replaced with appropriately sized nest boxes affixed to a retained tree.

- Constructed nest boxes should as priority target recorded hollow-dependent threatened species (and their prey species). Boxes should be constructed all of weatherproof timber (marine ply), fasteners and external paint and appropriately affixed to a recipient tree under the guidance of a fauna ecologist.

- If a threatened species is found to be occupying the hollow at the time of removal then this hollow section is to be reattached to a recipient tree within the nearby conservation areas as selected and directed by the fauna ecologist. The welfare and temporary holding of the residing animal(s) is at the discretion of the fauna ecologist.

- The relocated hollow section and nest boxes should be well secured in the recipient tree in a manner that will not compromise the current or future health of that tree.

- If any microbat emerges during the demolition of the building structures on site, then works are to immediately cease and then the advice of a fauna ecologist is to be sought to arrange safe relocation or handling. Both recorded threatened microbats are known to roost in such structures.

- Changes to stormwater runoff, pollutants and nutrients are addressed in the Water Sensitive Urban Design: Stormwater Assessment prepared by Saukutsu Pty Ltd. This assessment proposes several measures to effectively manage stormwater and mitigate the impacts of the development. These measures will mitigate any indirect effects on biodiversity values. Section 7 of the Stormwater Assessment states:

  "*Stormwater runoff modelling with DRAINS showed that the increased impervious areas due to the development can be adequately managed by the provision of basins on each pad. Stormwater quality modelling using MUSIC showed that the Liverpool City Council stormwater pollutant reduction target levels can be achieved using bio-retention area targeting the capture of pollutants from the roads and other hardstand areas, such as buildings and carparking areas. The bio-retention areas can be co-located within detention basins or distributed across the site, with due consideration of contributing catchment areas.*"

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Threatened & Migratory Species Habitat Assessment

A1

Table A1.1 provides an assessment of potential habitat within the development footprint for state and nationally listed threatened flora species recorded within 10 km on *BioNet* (DPIE) or indicated to have potential habitat present within 10 km on the *EPBC Act* Protected Matters Tool.

Table A 1.1 –Threatened flora habitat assessment

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Acacia bynoeana EPBC	E1	V	Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. *Distribution limits N-Newcastle S-Berrima.*	x	x	-	-	x	x
Acacia pubescens EPBC	V	V	Spreading shrub 1-4m high open sclerophyll growing in open forest and woodlands on clay soils. *Distribution limits N-Bilpin S-Georges River.*	x	marginal	x	x	x	x
Allocasuarina glareicola EPBC	E1	E	Small shrub 1-2m high growing in open sclerophyll forest on lateritic soils derived from tertiary alluviums. *Distribution limits Castlereagh NR region.*	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Ancistrachne maidenii DPIE	V	-	Decumbent grass. Grows in sandstone-derived soils. *Distribution limits Berowra Waters, Brooklyn and Wisemans Ferry.*	x	x	-	-	x	x
Cynanchum elegans DPIE EPBC	E1	E	Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. *Distribution limits N-Gloucester S-Wollongong.*	x	marginal	x	x	x	x
Dillwynia tenuifolia DPIE	V	-	Erect shrub 0.6-1m high. Grows in woodlands and open forest on sandstone, shale or laterite. *Distribution limits N-Howes Valley S-Cumberland Plain.*	x	marginal	5 km NE	2011	not likely	x
Epacris purpurascens var. *purpurascens* DPIE	V	-	Erect shrub to 1.5m high growing in sclerophyll forest and scrub and near creeks and swamps on sandstone. *Distribution limits N-Gosford S-Blue Mountains.*	x	x	-	-	x	x
Eucalyptus aggregata EPBC	V	V	Small or medium sized tree to approximately 18m tall. Grows usually on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Higher altitude species. *Distributed near to Blayney, Crookwell, Goulburn, Braidwood and Bungendore.*	x	x	-	-	x	x
Eucalyptus benthamii DPIE EPBC	V	V	Blue gum to 40m high. Wet forest on sandy alluvial soils. *Distribution limits N-Yarramundi S-Bents Basin.*	✓	-	-	-	-	✓

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Genoplesium baueri EPBC	E1	E	A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers Feb–Mar. *Distribution limits N – Hunter Valley S – Nowra.*	x	x	-	-	x	x
Grevillea juniperina subsp. *juniperina* DPIE	V	-	Erect to spreading shrub 0.5-1.5m tall. Grows on soils derived from Wianamatta Shale, laterite and Tertiary alluvium. *Distribution limits St Marys-Londonderry-Prospect.*	x	✓	5 km NE	✓	low	✓
Haloragis exalata subsp. *exalata* EPBC	V	V	Shrub to 1.5m high. Grows in damp places near watercourses. *Distribution limits N-Tweed Heads S-south of Eden.*	x	x	-	-	x	x
Isotoma fluviatilis subsp. fluviatilis	-	X		x	x	-	-	x	x
Melaleuca deanei EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. *Distribution limits N-Gosford S-Nowra.*	x	x	-	-	x	x
Micromyrtus minutiflora DPIE	E1	V	Spreading shrub to 2m high. Grows in dry sclerophyll forest dominated by Scribbly gums and Ironbarks on Tertiary Alluviums. *Distribution limits western part of Cumberland Plain.*	x	marginal	7 km NW	2014	not likely	x
Persicaria elatior EPBC	V	V	Herb to 90cm tall which grows in damp places especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. *Varied distribution from SE NSW to QLD.*	x	x	-	-	x	x
Persoonia acerosa EPBC	V	V	Erect to spreading shrub. Grows in heath or dry sclerophyll forest on sandstone. *Distribution limits N-Bilpin S-Hill Top.*	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Persoonia hirsuta EPBC	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. *Distribution limits N-Glen Davis S-Hill Top.*	x	x	-	-	x	x
Pimelea curviflora var. *curviflora* EPBC	V	V	Woody herb or sub-shrub to 0.2-1.2m high. Grows on Hawkesbury Sandstone near shale outcrops. *Distribution Sydney.*	x	x	-	-	x	x
Pimelea spicata DPIE EPBC	E1	E	Decumbent or erect shrub to 0.5m high. Occurs principally in woodland on soils derived from Wianamatta Shales. *Distribution limits N-Lansdowne S-Shellharbour.*	x	marginal	400 m E	✓	unlikely	✓
Pomaderris brunnea EPBC	V	V	Shrub to 3m high. *Confined to Upper Nepean and Colo Rivers where it grows in open forest.*	x	✓	x	x	not likely	x
Pterostylis chaetophora DPIE	V	-	A terrestrial orchid with a slender flowering stem to 40 cm with up to 5 closely sheathing stem leaves. Grows in seasonally moist, dry sclerophyll forest with a grass and shrub understorey. *Scattered locations in a relatively small area between Taree and Kurri Kurri, extending to the south-east towards Tea Gardens and west into the Upper Hunter, with additional records near Denman and Wingen. There are also isolated records from the Sydney region.*	x	marginal	x	x	x	x
Pterostylis saxicola EPBC	E1	E	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. *Distribution limits N-Hawkesbury River S-Campbelltown.*	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Pultenaea glabra EPBC	V	V	Erect shrub. Grows in moist, sheltered section of dry sclerophyll forest on sandstone in Higher Blue Mountains and Glen Davis areas.	x	x	-	-	x	x
Pultenaea parviflora DPIE EPBC	E1	V	Erect shrub. Grows in dry sclerophyll forest at the intergrade between Tertiary Alluviums and Wianamatta Shales. *Distribution limits Cumberland Plain.*	x	low	x	x	x	x
Rhodamnia rubescens DPIE	E4A	-	Shrub or small tree to 25 m high found in rainforest and riparian vegetation along the coast and up to 600m ASL. Flowers in late winter through to spring, with a peak in October, and fruits typically begin to appear in December in the Sydney region. Distribution limits N-Tweed Heads S-Batemans Bay.	x	x	-	-	x	x
Syzygium paniculatum EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. *Distribution limits N-Forster S-Jervis Bay.*	x	x	-	-	x	x
Tetratheca glandulosa DPIE	V	-	Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. *Distribution limits N-Mangrove Mountain S-Port Jackson.*	x	x	-	-	x	x
Thelymitra sp. 'Kangaloon' *(Thelymitra kangaloonica)* EPBC	CE	CE	A terrestrial orchid with dark blue flowers, presented in mid-late spring. *Only known from the Robertson area in the Southern Highlands.* Often in association with the endangered ecological community *Temperate Highland Peat Swamps on Sandstone.*	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***BC Act***	***EPBC Act***	**Growth form and habitat requirements** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Thesium australe EPBC	V	V	Erect herb to 0.4m high. Root parasite. Themeda grassland or woodland often damp. *Distribution limits N-Tweed Heads S-south of Eden.*	x	x	-	-	x	x

DPIE	- Denotes species listed within 10km of the development footprint on the *Atlas of NSW Wildlife*
EPBC	- Denotes species listed within 10km of the development footprint in the *EPBC Act* habitat search
V	- Denotes vulnerable listed species under the relevant Act
E or E1	- Denotes endangered listed species under the relevant Act
E4a or CE	- Denotes critically endangered listed species under the relevant Act
NOTE:	1. This field is not considered if no suitable habitat is present within the development footprint 2. 'records' refer to those provided by the *Atlas of NSW Wildlife* 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle

Table A1.2 provides an assessment of potential habitat within the development footprint for state and nationally listed threatened fauna species recorded within 10km on *Bionet* (DPIE) or indicated to have potential habitat present within 10km on the *EPBC Act* Protected Matters Tool.

Table A 1.2 – Threatened fauna habitat assessment

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Giant Burrowing Frog *Heleioporus australiacus* BIONET PMST	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. *Distribution limit: N-Near Singleton S-South of Eden.*	x	x	-	-	x	x
Stuttering Frog *Mixophyes balbus* PMST	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. *Distribution limit: N-near Tenterfield S-South of Bombala*.	x	x	-	-	x	x
Red-crowned Toadlet *Pseudophryne australis* BIONET	V	-	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. *Distribution limit: N-Pokolbin. S-near Wollongong.*	x	x	-	-	x	x
Green and Golden Bell Frog *Litoria aurea* BIONET PMST	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution limit: N-Byron Bay S-South of Eden.*	x	x	-	-	x	x

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Littlejohn's Tree Frog *Litoria littlejohnii* PMST	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. *Distribution limit: N-Hunter River S-Eden.*	x	x	-	-	x	x
Broad-headed Snake *Hoplocephalus bungaroides* PMST	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. *Distribution limit: N-Mudgee Park. S-Nowra.*	x	x	-	-	x	x
White-throated Needletail [MS] *Hirundapus caudacutus* BIONET PMST	-	V	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies often forage along favoured hilltops and timbered ranges. Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	✓	x	x	✓	✓
Black-necked Stork *Ephippiorhynchus asiaticus* BIONET	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. *Distribution limit: N-Tweed Heads. S-Nowra.*	x	Sub - optimal	x	x	Not likely	x

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Australasian Bittern *Botaurus poiciloptilus* BIONET PMST	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. *Distribution limit: N-North of Lismore. S- Eden.*	x	x	-	-	x	x
Black Bittern *Ixobrychus flavicollis* BIONET	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	✓	x	x	Not likely	x
White-bellied Sea Eagle (*Haliaeetus leucogaster*) BIONET PMST	V	-	Occupies coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs. *Sedentary; dispersive. N-Tweed Heads. S-South of Eden.*	✓	-	-	-	Recorded	✓
Little Eagle *Hieraaetus morphnoides* BIONET	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. *Distribution limit - N-Tweed Heads. S-South of Eden.*	x	✓	✓	✓	✓	✓

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Square-tailed Kite *Lophoictinia isura* BIONET	V	-	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. *Distribution limit: N-Goondiwindi. S-South of Eden.*	x	✓	✓	✓	✓	✓
Bush Stone-curlew *Burhinus grallarius* BIONET	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. *Distribution limit: N-Border Ranges National Park. S-Near Nowra.*	x	x	-	-	x	x
Australian Painted Snipe *Rostratula australis* PMST	E	E	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	Sub-optimal	x	x	Not likely	x
Black-tailed Godwit *Limosa limosa* BIONET	V	-	Regular summer migrant that forages along tidal mudflats, estuaries, sandspits, shallow river margins, sewerage ponds, inland on large shallow fresh or brackish waters. *Distribution limit: N-Tweed Heads. S-South of Eden*.	x	x	-	-	x	x
Gang-gang Cockatoo *Callocephalon fimbriatum* BIONET	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. *Distribution limit: mid north coast of NSW to western Victoria.*	x	✓	✓	✓	✓	✓

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Glossy Black-Cockatoo *Calyptorhynchus lathami* BIONET	V	-	Open forests with *Allocasuarina* species and hollows for nesting. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	x	-	-	x	x
Little Lorikeet *Glossopsitta pusilla* BIONET	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution limit: N-Tweed Heads. S-South of Eden*.	x	✓	✓	x	✓	✓
Swift Parrot *Lathamus discolour* BIONET PMST	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution limit: N-Border Ranges National Park. S-South of Eden*.	x	✓	✓	✓	✓	✓
Barking Owl *Ninox connivens* BIONET	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. *Distribution limit: N-Border Ranges National Park. S-Eden.*	x	Sub - optimal	✓	✓	✓	✓
Powerful Owl *Ninox strenua* BIONET	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. *Distribution limits: N-Border Ranges National Park. S-Eden.*	x	Marginal	✓	✓	✓	✓

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Masked Owl *Tyto novaehollandiae* BIONET	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. *Distribution limit: N-Border Ranges National Park. S-Eden.*	x	Marginal	x	✓	unlikely	✓
Sooty Owl *Tyto tenebricosa* BIONET	V	-	Tall, dense, wet forests containing trees with very large hollows. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	x	-	-	x	x
Brown Treecreeper *Climacteris picumnus victoriae* BIONET	V	-	Occupies eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. *Distribution limit: (Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.*	x	Sub - optimal	x	✓	Unlikely	✓
Speckled Warbler *Chthonicola sagittata* BIONET	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution limit: N-Urbanville. S-Eden.*	x	marginal	x	x	Not likely	x
Regent Honeyeater *Xanthomyza Phrygia* BIONET PMST	E4A	CE	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution limit: N-Urbanville. S-Eden.*	x	✓	✓	✓	✓	✓

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					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Painted Honeyeater *Grantiella picta* PMST	V	V	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. *Distribution limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.*	x	✓	x	x	Not likely	x
Black-chinned Honeyeater *Melithreptus gularis gularis* BIONET	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. *Distribution limit: N-Cape York Pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.*	x	Marginal	x	x	Unlikely	✓
Varied Sittella *Daphoenositta chrysoptera* BIONET	V	-	Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	✓	x	✓	✓	✓

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					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Dusky Woodswallow *Artamus cyanopterus cyanopterus* BIONET	V	-	Found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. Prefers habitat with an open understorey. Often observed in farmland tree patches or roadside remnants. *Widespread in eastern, southern and south-western Australia.*	x	✓	✓	✓	✓	✓
Hooded Robin *Melanodryas cucullata cucullata* BIONET	V	-	Found in eucalypt woodlands, *Acacia* scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. *Distribution limit: N-Central Qld. S-Spencer Gulf SA.*	x	Marginal	✓	x	Unlikely	✓
Scarlet Robin *Petroica boodang* BIONET	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	Sub-optimal	✓	✓	low	✓
Flame Robin *Petroica phoenicea* BIONET	V	-	Summer: forests, woodlands, scrubs, from sea-level to *c.* 1800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. *Distribution limit: N northern NSW tablelands. S-South of Eden.*	x	Sub-optimal	x	x	Not likely	x

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Diamond Firetail *Stagonopleura guttata* BIONET	V	-	Found in eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *Distribution limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.*	x	Sub-optimal	✓	x	Unlikely	✓
Spotted-tailed Quoll *Dasyurus maculatus* BIONET PMST	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. *Distribution limit: N-Mt Warning National Park. S-South of Eden.*	x	x	-	-	x	x
Koala *Phascolarctos cinereus* BIONET PMST	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution limit: N-Tweed Heads. S-South of Eden.*	x	Sub-optimal	✓	✓	Not likely	x
Yellow-bellied Glider *Petaurus australis* BIONET	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	Sub-optimal	x	x	Not likely	x

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Greater Glider *Petauroides volans* BIONET PMST	-	V	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Population density is optimal at elevation levels at 845 m above sea level. Prefer overstorey basal areas in old-growth tree stands. Highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows *Distribution limit: N-Border Ranges National Park. S- South of Eden.*	x	marginal	x	✓	Not likely	x
Brush-tailed Rock-wallaby *Petrogale penicillata* BIONET PMST	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. *Distribution limit: N-North of Tenterfield. S-Bombala.*	x	x	-	-	x	x
Grey-headed Flying-fox *Pteropus poliocephalus* BIONET PMST	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. *Distribution limit: N-Tweed Heads. S-Eden.*	x	✓	✓	✓	✓	✓
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* BIONET	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution limit: N-North of Walgett. S-Sydney.*	x	✓	x	✓	✓	✓

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Eastern Coastal Free-tailed Bat *Micronomus norfolkensis* BIONET	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. *Distribution limit: N-Woodenbong. S-Pambula.*	✓	-	-	-	Recorded	✓
Large-eared Pied Bat *Chalinolobus dwyeri* BIONET PMST	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. *Distribution limit: N-Border Ranges National Park. S-Wollongong.*	x	✓	✓	✓	✓	✓
Eastern False Pipistrelle *Falsistrellus tasmaniensis* BIONET	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution limit: N-Border Ranges National Park. S-Pambula.*	x	Sub-optimal	x	✓	✓	✓
Southern Myotis *Myotis macropus* BIONET	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	✓	-	-	-	Recorded	✓

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Greater Broad-nosed Bat *Scoteanax rueppellii* BIONET	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. *Distribution limit: N-Border Ranges National Park. S-Pambula.*	x	✓	✓	✓	✓	✓
Little Bent-winged Bat *Miniopterus australis* BIONET	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution limit: N-Border Ranges National Park. S-Sydney.*	x	✓	✓	✓	✓	✓
Large Bent-winged Bat *Miniopterus orianae oceanensis* BIONET	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	✓	✓	✓	✓	✓
New Holland Mouse *Pseudomys novaehollandiae* PMST	-	V	Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1m high and sparse ground litter. Recolonise of regenerating burnt areas. *Distribution limit: N-Border Ranges National Park. S-South of Eden.*	x	x	-	-	x	x

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
The Golden Sun Moth *Synemon plana* PMST	E	-	Inhabits natural treeless grasslands containing *Austrodanthonia carphoides. Distribution limit: Southern Tablelands and South West Slopes.*	x	x	-	-	x	x
Cumberland Plain Land Snail *Meridolum corneovirens* BIONET	E	-	Inhabits remnant eucalypt woodland of the Cumberland Plan. Shelters under logs, debris, clumps of grass, around base of trees and burrowing into loose soil. *Distribution limit: Cumberland Plain of Sydney Basin Bioregion.*	x	Sub-optimal	✓	✓	low	✓
Dural Land Snail *Pommerhelix duralensis* BIONET PMST	E	E	Occurs on shale-sandstone transitional forest landscapes within the Blue Mountains, Penrith, The Hills, Wollondilly, Hornsby and Parramatta LGA's. Occurs in low abundance and shelters under rocks or inside curled-up bark, beneath leaves and light woody debris. *Distribution limit: St Albans to Mulgoa with most records from The Hills LGA.*	x	x	-	-	x	x
Macquarie Perch *Macquaria australasica* PMST	V (*FM Act 1994*)	E	Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes.	x	✓	✓ habitat mapping	x	low	✓

Common name ***Scientific name*** Database source	***BC Act***	***PMST Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in assessment of significance test (✓) Refer to Appendix 2**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Australian Greyling *Prototroctes maraena* PMST	Part 2, Section 19 – Protected Fish (*FM Act 1994*)	V	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls).	x	x	-	-	x	x

BIONET	Denotes species listed within 10km of the development footprint on the *Bionet* search (Atlas of NSW Wildlife) managed by BIONET
PMST	Denotes species listed within 10km of the development footprint in the *Protected Matters Search Tool* managed by DAWE
TBE	Denotes additional species considered by *Travers bushfire & ecology* to have potential habitat based on regional knowledge and other records
V	Denotes vulnerable listed species under the relevant Act
E or E1	Denotes endangered listed species under the relevant Act
E4a or CE	Denotes critically endangered listed species under the relevant Act
NOTE:	1. This field is not considered if no suitable habitat is present within the development footprint 2. 'records' refer to those provided by the *Atlas of NSW Wildlife* 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle
Unlikely	Represents such a low margin but not enough to 100% rule it one. A test of significance is required.
Not likely	Means 0% change of occurring, despite there being potential habitat. A test of significance is not applied to these species.

Table A1.3 provides an assessment of potential habitat within the development footprint for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A1.2.

Table A 1.3 – Migratory fauna habitat assessment

Common name ***Scientific name***	**Preferred habitat** ***Migratory breeding***	**Suitable habitat present (✓)**	**Recorded on site (✓)**	**Comments**
Oriental Cuckoo (*Cuculus optatus*)	Mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	x	x	-
Fork-tailed Swift (Apus pacificus)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.	✓	x	-
Rainbow Bee-eater (*Merops ornatus*)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. *Breeding resident in northern Australia. Summer breeding migrant to south east and south west Australia.*	✓	x	-
Black-faced Monarch (*Monarcha melanopsis*)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. *Summer breeding migrant to coastal south east Australia, otherwise uncommon*.	✓	x	-
Spectacled Monarch (*Monarcha trivirgatus*)	Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. *Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept / Oct to May. Uncommon in southern part of range.*	x	x	-
Satin Flycatcher (*Myiagra cyanoleuca*)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south-east Australia and Tasmania over warmer months, winters in north east Qld.*	✓	x	-
Rufous Fantail (*Rhipidura rufifrons*)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. *Breeding migrant to south-east Australia over warmer months. Altitudinal migrant in north-east NSW in mountain forests during warmer months.*	✓	x	-
Yellow Wagtail (*Motacilla flava*)	The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops.	✓	x	-

Common name ***Scientific name***	**Preferred habitat** ***Migratory breeding***	**Suitable habitat present (✓)**	**Recorded on site (✓)**	**Comments**
Common Greenshank (*Tringa nebularia*)	Found in a wide variety of inland wetlands and sheltered coastal habitats (with large mudflats and saltmarsh, mangroves or seagrass) of varying salinity, Habitats include embayments, harbours, river estuaries, deltas and lagoons. It uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. Also artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. In NSW the Hunter River estuary has been identified as a site of international importance. *Breeds in Eurasia, the northern British Isles, Scandanavia, east Estonia and north-east Belarus, through Russia and east.*	x	x	-

Test of Significance A2

Section 7.3 of the *BC Act* requires a determination as to whether a development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. Henceforth this is referred to as the 'test of significance'.

For the purposes of this part, development or an activity is likely to significantly affect threatened species if:

(a) it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in Section 7.3, or
(b) the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or
(c) it is carried out in a declared area of outstanding biodiversity value.

Section 7.3 of the *BC Act* provides the terms of the test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats.

The following test of significance relies on the biodiversity assessment provided in this report and should be read making reference to the relevant discussion on each threatened species or their habitats, endangered population and ecological community.

Flora investigations and fauna habitat assessments of the study area have resulted in the identification of suitable habitat for the following threatened species and populations with varying potential to occur. Species recorded or with a considered potential to occur have been noted. The potential for any direct or indirect impacts on these species has also been considered and noted.

Threatened flora

Scientific name	BC Act	Potential to occur	Potential impact
Eucalyptus benthamii	V	recorded	No impact

Threatened ecological communities

- *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* – (RFEF) endangered
- *Cumberland Plain Woodland in the Sydney Basin Bioregion* – (CPW) critically endangered

Threatened fauna

Common name	*BC Act*	Potential to occur	Potential habitat impact
White-bellied Sea Eagle	V	Recorded	Direct – removal of open terrestrial foraging
Eastern Coastal Free-tailed Bat	V	Recorded	Direct – on open foraging and potential roosting/breeding
Southern Myotis	V	Recorded	Direct – connectivity between foraging and potential roosting/breeding
White-throated Needletail	-	✓	None anticipated
Little Eagle	V	✓	Direct – on open foraging
Square-tailed Kite	V	✓	Direct – on open foraging
Gang-gang Cockatoo	V	✓	Direct – on foraging
Little Lorikeet	V	✓	Direct – on foraging and potential roosting/breeding
Swift Parrot	E	✓	Direct – on winter foraging
Barking Owl	V	✓	Direct – on foraging and low potential roosting/breeding
Powerful Owl	V	✓	Direct – on foraging
Regent Honeyeater	E4A	✓	Direct – on winter foraging
Varied Sittella	V	✓	Direct – on foraging and low potential roosting/breeding
Dusky Woodswallow	V	✓	Direct – on foraging and potential roosting/breeding
Grey-headed Flying-fox	V	✓	Direct – on seasonal foraging
Yellow-bellied Sheathtail-bat	V	✓	Direct – on foraging and low potential roosting/breeding
Large-eared Pied Bat	V	✓	Direct – on foraging
Eastern False Pipistrelle	V	✓	Direct – on foraging and low potential roosting/breeding
Greater Broad-nosed Bat	V	✓	Direct – on foraging and potential roosting/breeding
Little Bent-winged Bat	V	✓	None anticipated
Large Bent-winged Bat	V	✓	None anticipated
Scarlet Robin	V	Low	Direct – on low potential foraging
Cumberland Plain Land Snail	E	Low	Direct – on low potential habitat
Macquarie Perch	V (*FM Act*)	Low	None anticipated
Masked Owl	V	Unlikely	Direct – on unlikely potential foraging
Brown Treecreeper	V	Unlikely	Direct – on low potential foraging
Black-chinned Honeyeater	V	Unlikely	Direct – on unlikely potential foraging, roosting/breeding
Hooded Robin	V	Unlikely	Direct – on unlikely potential foraging, roosting/breeding
Diamond Firetail	V	Unlikely	Direct – on unlikely potential foraging, roosting/breeding

Endangered populations

- None for flora
- None for fauna

***BC ACT 2016* - SECTION 7.3 – TEST OF SIGNIFICANCE**

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

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

The direct and indirect impacts of the proposal are considered within Section 5.

With consideration to the relative direct and indirect impacts on all threatened species with varying potential to occur, it is considered that the proposal is unlikely to disrupt the life cycle for any of these listed species such that a viable local population would be placed at risk of extinction. Species recorded present during survey, previously recorded nearby or with high potential to occur and requiring further discussion given potential impacts are further discussed in detail below.

Summary of threatened species recorded

Eucalyptus benthamii

Smooth-barked eucalypt to 40 m high. Occurs in wet forest on sandy alluvial soils. Three (3) individuals were observed in the far western portion of the study area adjacent to the Nepean River. These individuals are well outside the proposed development footprint and will not be impacted. The prepared VMP defines actions to protect *E. benthamii* on site, and restore the surrounding vegetation.

White-bellied Sea-Eagle

The White-bellied Sea-Eagle is mostly recorded in coastal lowlands, but can occupy habitats up to 1400 m above sea level on the Northern Tablelands of NSW. It also extends inland along some of the larger waterways, especially in eastern Australia. Habitats occupied are characterised by the presence of large areas of open water (larger rivers, freshwater swamps, lakes, billabongs, reservoirs, but also saltmarsh and sewage ponds). They also occur at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves. Birds have been recorded in (or flying over) a variety of terrestrial habitats including coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas.

Breeding territories are located close to water, and mainly in tall open forest or woodland, although nests are sometimes located in other habitats such as dense forest (including rainforest), closed scrub or in remnant trees on cleared land. The breeding season extends from June to January and the nest is a large structure composed of sticks and lined with leaves, grass or seaweed. Pairs usually return to the same breeding territory each year, and often the same nest, although territories tend to contain one or two additional, less developed nests. Breeding pairs tend to be widely dispersed, and are generally separated by distances of several kilometres or more.

Sea Eagle was recorded on both fauna survey dates. On the second survey, three individuals were observed in flight heading towards the river in a WNW direction. One of these appeared to retain some juvenile plumage. This combined with the numbers present, the flight direction and time of day, it is assumed that a nest is located in the locality expected to be to the north. No nest was observed present within the study area or within trees directly adjacent on the other side of the river.

White-bellied Sea Eagle may forage within the study area including potential to perch surrounding the existing large dam on the edge of the depression SW wetland, along the creek or particularly along the river. Most of this habitat will be retained by the proposal, however removal of the open landscape between these and increased human presence and infrastructure may reduce this potential. Despite this, an adequate buffer will be provided to any local nesting location, and foraging / perching habitat will remain well represented in the locality such that the White-bellied Sea Eagle will not likely be significantly impacted.

East-coast Freetail Bat

The Eastern Coastal Free-tailed Bat forages above the canopy of open forests and woodlands and in clearings at forest edges, feeding on small insects (Allison, Hoye & Law 2008). This species is thought to roost predominantly in tree hollows but also under loose bark and occasionally in houses and outbuildings (Allison, Hoye & Law 2008). Until recent findings of a roost within mangroves, all known natural roosts had occurred within hollow spouts of large mature eucalypts. The species is often found close to dams and waterholes. The Eastern Coastal Free-tailed Bat species will utilize paddock trees and isolated remnant vegetation when in proximity to larger forest remnants (Allison, Hoye & Law 2008).

It is considered that the study area provides suitable roosting, breeding and foraging habitat for the East-coast Freetail Bat, particularly given presence of hollows of various types and size characteristics.

This species was recorded during surveys at the large eastern dam and the central creek line edge. Activity levels were sufficient to indicate a roosting location may be present within the study area. Most habitat containing hollows will be retained by the proposal, however some hollows will likely be removed within the development landscape.

Recent studies by Anna McConville from the University of Newcastle found the preferred habitat for Eastern Coastal Free-tailed Bat was identified as productive floodplain areas, especially freshwater wetland, with urban land use and dry sclerophyll forest avoided. Based on the current little known habitat knowledge and ecology of this species, it would be expected that the open water areas of the adjacent creek and dam, likely provide most valued foraging habitat for this species.

As the locating of bat roost sites by survey is an exhaustive, costly and unreliable process, the assessment for hollow-dependent threatened microbats is often based on the available habitat present and retained for the species within the nearby locality. In this respect the proposed VMP conservation actions as well as other areas of nearby local habitat will remain extensive. Mitigation measures have also been carefully advised to ensure if a roosting colony is present within the development landscape, then this may be effectively recovered and relocated within the hollow to an appropriate recipient tree. Such measures also justify the retention of an internal corridor retained through the study area.

It is therefore concluded that the proposed development will not likely significantly impact on a local population of East-coast Freetail Bat.

Large-footed Myotis

The Southern Myotis inhabits rainforests and open forests containing creeks and lakes over which it feeds and roosts in tree hollows, caves, mines, under bridges, in tunnels and occasionally buildings (Richards 1995). The Southern Myotis predominantly forages along creeklines and over waterbodies where it takes insects and small fish from on and just below the water surface (Richards 1995).

This species has a strong association with streams and permanent waterways, most frequently at low elevations and in flat or undulating country and usually in areas that are vegetated rather than cleared. They will live in most habitat types as long as it is near water (Churchill 2008).

The Southern Myotis has been recorded from ultrasonic calls foraging over the large dam in the north-eastern portion of the site, and to the west of the study area along the Nepean River.

The study area is likely utilised by several individuals of Southern Myotis. The number utilising the adjacent river for foraging could vary at different times and on occasion be utilised by many. The individuals that do forage adjacent to the study area are likely to vary in accordance with local roosting behaviour. Roosting may be temporary and solitary or up to several individuals occupying more long-term roosting locations.

Several roosting locations are expected to occur through the locality and these would include others within the connective habitats to the north, west and south-east. Many available roosting structures for this species provided by large stormwater culverts, hollows, large old structures and the underside of over-water bridges would contribute to a local roosting network. Open water foraging areas are where many bats from separate roosting colonies are likely to interact and movement between different roosts will result. Hence the populations and roosting locations sometimes swell and are sometimes vacated and the local population(s) are dynamic.

Available roosting opportunities will be various but generally located close to water. If a roost is present within the study area this would be provided by a tree hollow. A roost within the proposed development landscape should obviously not be ruled out.

As the locating of bat roost sites by survey is an exhaustive, costly and unreliable process, the assessment for hollow-dependent threatened microbats not recorded in the development footprint area is often based on the available habitat present and retained for the species within the nearby locality. In this respect the retained vegetation areas, as well as other areas of nearby local habitat, will remain extensive. Therefore it is concluded that the proposed development will not likely significantly impact on a local population of Large-footed Myotis.

Careful habitat removal measures, relocation of suitable hollows and provision of supplementary habitat measures for this species have been considered and incorporated into the mitigation and amelioration of impacts outlined in Section 6.2.

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

Two (2) TECs – CPW and RFEF – were observed within the development footprint.

CPW

The proposal will likely remove 0.49 ha of CPW out of a total of 4.33 ha within the study area. This impact equates to 14% of all CPW on site. The proposed VMP will fully restore an additional 1.19 ha of CPW within the site, which will ultimately lead to an increase in the area of CPW on site. Overall, there will be a gain of 0.7 ha of CPW within the study area.

Within the locality this vegetation community corresponds with Shale Plains Woodland and Shale Hills Woodland in the Vegetation Mapping of the Cumberland Plain (NPWS 2002), which combined are mapped as occupying over 100 ha within their local occurrence. The impact of 0.49 ha equates to approximately 0.49% of the local occurrence of this community.

Generally, an impact on a CEEC of under 0.5 ha is considered a non-significant impact. This is particularly the case if the vegetation is in a highly modified condition with disturbed understorey, as it is on site. With the revegetation as part of the VMP there will be a total net gain in CPW of 0.7 ha that will mitigate the loss of this vegetation.

It is therefore considered that the proposed development is unlikely to have an adverse effect on the extent of this ecological community such that its local occurrence is likely to be placed at risk of extinction, and will actually provide a positive conservation outcome for CPW through the implementation of the VMP.

RFEF

The proposal will likely remove 0.16 ha of RFEF out of a total of 3.5 ha within the study area. This impact equates to 3.69% of all RFEF on site. The proposed VMP will fully restore an additional 9.42 ha of CPW within the site, which will more than triple the area of RFEF. Overall, there will be a gain of 9.02 ha within the study area.

Within the locality this vegetation community corresponds with Alluvial Woodland and Riparian Forest in the Vegetation Mapping of the Cumberland Plain (NPWS 2002), which combined are mapped at occupying over 98 ha within their local occurrence. The impact of 0.16 ha equates to approximately 0.16% of the local occurrence of this community.

With the revegetation as part of the VMP there will be a total net gain in RFEF of 9.26 ha that will mitigate the loss of this vegetation.

It is therefore considered that the proposed development is unlikely to have an adverse effect on the extent of this ecological community such that its local occurrence is likely to be placed at risk of extinction, and will actually provide a positive conservation outcome for RFEF through the implementation of the VMP.

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 CPW and RFEF vegetation communities are currently highly disturbed with moderate to high abundance of exotic weeds within the ground shrub and tree layers. The proposal will not adversely modify the composition of these communities. The actions proposed in the VMP will restore 2.7 ha of retained CPW and 4.08 ha of retained RFEF to fully-structured vegetation, including trees, shrubs and groundcovers. This will greatly improve the composition of these TECs on site, and will involve targeted weed control and enrichment planting. As mentioned above, an additional 1.19 ha of CPW and 9.42 ha RFEF will be revegetated within the site under the VMP. These proposed actions will lead to a net positive outcome for both TECs on site.

With these actions the proposed development will overall not adversely modify the composition of these communities such that their local occurrence is likely to be placed at risk of extinction. Through implementation of the VMP, the proposal will improve the composition of these TECs and contribute to their conservation in the medium to long term.

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

It is considered that the habitat attributes of the development footprint provide known or potential habitat for *Eucalyptus benthamii,* CPW, RFEF, White-bellied Sea Eagle, Little Eagle, Square-tailed Kite, Gang-gang Cockatoo, Little Lorikeet, Swift Parrot, Barking Owl, Powerful Owl, Masked Owl, Brown Treecreeper, Regent Honeyeater, Black-chinned Honeyeater, Varied Sittella, Dusky Woodswallow, Hooded Robin, Scarlet Robin, Diamond Firetail, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, Eastern Coastal Free-tailed Bat, Large-eared Pied Bat, Eastern False Pipistrelle, Southern Myotis, Greater Broad-nosed Bat, Little Bent-winged Bat, Large Bent-winged Bat, Cumberland Plain Land Snail and Macquarie Perch.

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

The proposed development is likely to remove a total of 0.65 ha of native vegetation providing habitat for the aforementioned species.

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 development has been located to retain existing connectivity values along the Nepean River and Duncans Creek. Connectivity of the main patch of CPW in the north east to adjacent vegetation off site will also be maintained. All other areas of vegetation are already isolated and the proposal will not further isolate these fragments.

Therefore, it is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated or fragmented as a result of the proposal.

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

In respect to threatened fauna species recorded or with potential to occur the proposed area of impact is not likely of high quality, of any breeding importance or central to the home range requirements of any species such that behaviour or ecology of these species will be significantly altered in any way.

The existing TEC vegetation is in poor condition. The removal of 0.65 ha of this poor-quality TEC vegetation is considered of low importance, particularly given the VMP actions to regenerate retained vegetation and more than double the total area of TEC vegetation through revegetation. This will provide a net positive outcome for the habitat on site and will likely increase the long-term survival of the TECs present.

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 development footprint is not within any declared area of outstanding biodiversity value. Therefore, the proposal will not have any adverse effects on any declared area of outstanding biodiversity value (either directly or indirectly).

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

A key threatening process is defined as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities.

The current list of key threatening processes, and whether the proposed activity is recognised as a threatening process, is shown below.

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	**Possible**	**Unlikely**
Aggressive exclusion of birds by Noisy Miners (*Manorina melanocephala*)			✓
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands		✓	
Anthropogenic Climate Change		✓	
Bushrock removal			✓
Clearing of native vegetation	✓		
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants into NSW			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
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		✓	
Infection of native plants by *Phytophthora cinnamomi*		✓	
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch Broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Bufo marinus*)			✓
Invasion, establishment and spread of *Lantana camara*			✓
Invasion of native plant communities by bitou bush & boneseed *Chrysanthemoides monilifera*			✓
Invasion of native plant communities by exotic perennial		✓	

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	**Possible**	**Unlikely**
grasses			
Invasion of native plant communities by African Olive (*Olea europaea* subsp. *cuspidata*)		✓	
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*)			✓
Loss of Hollow-bearing trees	✓		
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants		✓	
Loss and/or degradation of sites used for hill-topping by butterflies			✓
Predation and hybridisation by feral dogs (*Canis lupus familiaris*)			✓
Predation by the European Red Fox (*Vulpes vulpes*)			✓
Predation by the Feral Cat (*Felis catus*)			✓
Predation by Gambusia holbrooki Girard, 1859 (plague minnow or mosquito fish)			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (*Sus scofa*)			✓
Removal of dead wood and dead trees		✓	

The above key threatening processes have been considered in reference to the proposal. It was considered that the proposal may contribute to a small degree to a number these processes as described below. It was not considered that the proposal will have a large or significant impact on any of the following key threatening processes. Some mitigation measures have been listed under each process to minimise or reduce such impacts upon those processes.

Summary of "likely" or "possible" Key Threatening Processes

This section identifies what mitigation measures can be implemented to address threatening processes.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

In accordance with the Water Management Act, consideration is to be given to the impact of the proposed action on local watercourses and native vegetation riparian buffers and stormwater measures will need to be implemented in accordance with a required Controlled Activity Approval issued by the NRAR. The proposal is likely to modify stormwater runoff from development areas (impermeable road and property surfaces) and concentrate this increased flow into Duncans Creek. Water-sensitive urban design has been incorporated into the design of the proposal and will minimise environmental degradation and improve aesthetic and recreational appeal. The Water Sensitive Urban Design: Stormwater Assessment prepared by Saukutsu Pty Ltd. proposes several measures to effectively manage stormwater and mitigate the impacts of the development.

Human-caused Climate Change

The proposal will require the removal of a small amount of vegetation which will result in a negative or positive contribution to climate change. Vegetation is considered to act as a sink for a range of greenhouse gases but in particular Carbon Dioxide. The maintenance of native vegetation cover is a key strategy to combat the contributing impacts of the proposed action on Climate Change. Increased risk of bushfire, flooding and storms are to be considered as part of the proposed action. This issue requires total systems management including consideration of energy use throughout the lifecycle of the proposed action including all aspects of the actions processes, materials supply and production. Whilst almost insignificant in size, the proposal is part of the accumulative effect and thus should be considered as contributing to this threatening process.

The proposed planting of additional vegetation through the VMP will more than double the amount of vegetation on site. This has potential to offset any carbon emissions associated with the development.

Clearing of native vegetation

The proposal is of a class of development recognised as a threatening process. It is generally recommended that all sites should aim to achieve a maintain or improve outcome on the quality and quantity of native vegetation cover through protection and restoration measures. The vegetation management process is to be undertaken in accordance with the conditions of consent and any required vegetation and tree management plans for the proposed development. Revegetation of native vegetation through the VMP will more than double the amount of vegetation within the site and will more than offset the loss of native vegetation.

Infection of native plants by Phytophthora cinnamomi

The proposal may temporarily increase the risk of fungal infection on site as it may be spread via vehicular movement and relocation of soil and vegetation. Consequently, standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres or tracks. Any equipment found to contain soil or vegetation material from offsite is to be cleaned in a quarantined work area or wash station and treated with anti-fungal pesticides prior to commencing work.

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

'Myrtle Rust' may be spread via machinery, animals and humans as well as by environmental factors such as wind. The presence of machinery and construction works is likely to slightly increase the potential for spread of this key threatening process. Similar protocols as to *Phytophthora cinnamomi* should be applied.

Invasion, establishment and spread of Lantana camara

The site currently contains this species, however it is expected that the proposed development and VMP will provide an opportunity to remove, control and manage this species throughout the whole of the site.

Invasion of native plant communities by African Olive (Olea europaea subsp. cuspidata)

This species is present on the development footprint. The proposed development and VMP will provide an opportunity to ameliorate the effect of this key threatening process.

Invasion of native plant communities by exotic perennial grasses

The proposal is of a class of development recognised as a threatening process due to possible incursions of grasses such as *Cenchrus clandestinus* (Kikuyu). However, the vegetation within the development footprint is of a degraded nature and the proposed development is not expected to significantly increase the prevalence of exotic perennial grasses. It is expected that implementation of the VMP will decrease the number of exotic grass species and will provide an opportunity to manage the area with regard to weed invasion.

Loss of hollow-bearing trees

Hollow-bearing tree surveys identified 23 hollow-bearing trees containing small (0-10 cm) medium (10-30 cm) and large (>30 cm) sized hollows within the development footprint. The proposal will likely require the removal of several of these hollow-bearing trees, including three significant habitat trees (SHT21, SHT22 and SHT23 - Figure 2.2) and as such is of a class of development recognised as a threatening process. Threatened species with suitable habitat within the site and dependant on hollows of this nature include East-coast Freetail Bat and Southern Myotis. It is not considered that the loss if these hollows will have a significant impact on threatened fauna.

Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants

The invasion and establishment of escaped garden plants is likely where such species are used for landscaping. It is recommended that non-invasive and locally-occurring species are used for landscaping purposes throughout the site. The implementation of the VMP will help control any escaped garden plants.

Removal of dead wood and dead trees

The proposal will likely require the removal of deadwood and dead trees and as such is of a class of development recognised as a threatening process. Threatened fauna species dependent on dead wood or dead trees have not been recorded within the development footprint. White-bellied Sea Eagle was observed using dead trees as a perch only. Given the low-quality habitat associated with deadwood and dead trees present within the development areas, the removal of dead wood and dead trees is not considered likely to impact on threatened species or the biodiversity of the local area.

National - Significant Impact Criteria

A3

Under the *EPBC Act* an action will require approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The following significant impact criteria were sourced from the *EPBC Act* Policy Statement 1.1 (May 2006):

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

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

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

>> What is a population of a species?

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

>> What is habitat critical to the survival of a species or ecological community?

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:
- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long-term evolutionary development; or
- For the reintroduction of populations or recovery of the species or ecological community.

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

VULNERABLE SPECIES

Significant impact criteria

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

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

>> What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

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

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

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

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

MIGRATORY SPECIES

Significant impact criteria

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

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

>> What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

a) Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
b) Habitat that is of critical importance to the species at particular life-cycle stages; and/or
c) Habitat utilised by a migratory species which is at the limit of the species range; and/or
d) Habitat within an area where the species is declining.

>> What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

>> What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.