Travers

bushfire & ecology

Flora & fauna assessment

71 St Andrews Road
Varroville

December 2018
(REF: 18GAT03)

Flora & Fauna Assessment

71 St Andrews Road
Varroville

DECEMBER 2018

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File:	18GAT03

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Executive Summary

Travers bushfire & ecology has been engaged to prepare an updated flora and fauna assessment for a proposed rezoning within Lot 71 DP 706546, 71 St Andrews Road, Varroville. The entire area of this lot has been subject to ecological survey effort and will hereafter be referred to as the 'study area'. In some circumstances survey has however extended slightly beyond this boundary.

Travers bushfire & ecology undertook flora and fauna survey in November 2017 and additional vegetation assessment in November 2018. The vegetation mapping (November 2018) has been prepared in accordance with the BAM Methodology and accurately represents the cover and condition of vegetation onsite. *Gunninah* have undertaken a previous ecological assessment for the study area from site visits undertaken in 2014 and 2015 for a previous planning proposal. The species records have been considered and incorporated into this report where appropriate.

Consultation with Campbelltown Council on the 9th of November 2018, Council's ecologists requested updated floristic survey of the site, re-examine the vegetation mapping and to demonstrate an avoidance of impact. This is a direct result of the site having been raked immediately prior to the November 2017 survey session for the purposes of removing light wood and pasture improvement. *Travers bushfire and ecology* note the concern raised by Council that the current land management is inconsistent with the current zoning. In addition, it is noted that the current land management which includes grazing of a small number of animals has an influence on the quality of the existing vegetation and its existing ecological value.

To overcome the land management in November 2017 it was agreed by Council's ecologists that resurvey was appropriate under the circumstances and that the land be spelled for approximately 7-8 months to provide an opportunity for understory vegetation to regenerate. During that time, there was also one major rainfall event following an extended dry period.

The joint inspection with Councils ecologist in November 2018 revealed that the understorey had commenced to regenerate in selected locations but the ground was still mostly bare except in lower lying areas that benefited more from the recent rains. The site inspection also revealed various stock piles of native vegetation brush near quadrat 5 that may have been under scrubbed at an undetermined time.

Travers bushfire & ecology would have expected significantly more understory regeneration on site and consider that current management practices are preventing regeneration of native vegetation to any significant extent. Despite the vegetation management works the species diversity is low and not reflective of recently cleared vegetation but of long term pasture management and removal of timber consistent with ongoing grazing management.

Whilst this current management is inconsistent with the current zoning, the condition of the vegetation would suggest that the vegetation within the understorey is quite disturbed and is likely to have a low resilience given the long-term management within the site. The existing vegetation on the western side of the electrical easement is highly managed and is unlikely to regenerate to any vegetative form without a significant spell of many years and supplementary revegetation works will be required to reintroduce native understorey and shrub layers.

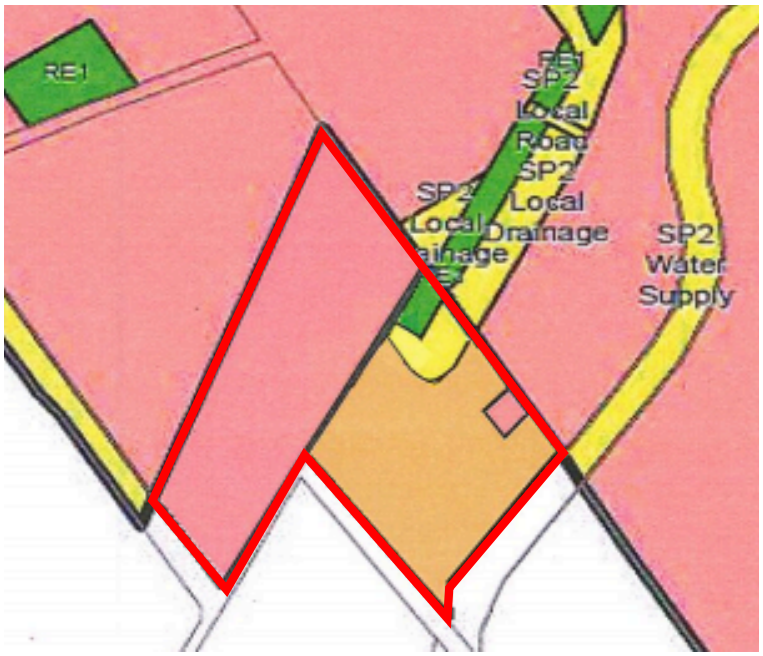
Additional plots were undertaken on adjoining lots as requested by Councils ecologist on the expectation that transitional arrangements of the BC Act would cease on the 25th of November 2018. However, as the savings and transitional provisions have been extended until 25 November 2019, this project must be assessed in accordance with the requirements of the TSC Act. *Travers bushfire & ecology* consider it inappropriate to rely on information from plots on adjoining lands that are reflective of a significantly different management history but also varying degrees of vegetation management from fire, understorey management and partial clearing.

This flora and fauna assessment has however relied on updated BAM plots within the site to provide accurate representation of the existing vegetation at the time of survey.

Proposed development

The study area is currently zoned E3 Environmental Management. As the site is located within the Campbelltown local government area (LGA), this project is being assessed under the *Threatened Species Conservation Act* (*TSC Act*, 1995) in accordance with the *Biodiversity Conservation (Savings and Transitional) Regulations, 2017.* Local developments in the Campbelltown LGA may submit proposals under the *TSC Act* until November 25th, 2019.

The proposal as shown below is for the rezoning of the lands to the north-western side of the powerline easement and subsequent subdivision to R2 residential. The south-eastern portion of the site is proposed to be retained as E3 Environmental Management with a small pocket of R2 to accommodate a single dwelling and asset protection zone. RE1 and SP2 are proposed to be extended into the site for stormwater and drainage works.



Proposed zonings

The proponents are currently intending to establish a biodiversity stewardship site on the E3 zoned lands and to use this as a potential offset for the proposed subdivision. This strategy is subject to a future Biodiversity stewardship assessment at prior to a subdivision DA. The E3 lands are likely to have either a restriction of the use of that title under an 88B Instrument or a conservation agreement of some form which may include a Biodiversity Stewardship Agreement under the *Biodiversity Conservation Act* (*BC Act*) 2016.

Future works within the E3 lands allow a single dwelling with associated works and APZ, and a stormwater detention basin. The stormwater detention basin has now been sized and its location shown Figure 1 – Concept Services Plan.

Avoidance of impact

It is noted that a demonstrated avoidance of impact was requested on the 9th of November 2018 by Council's ecologists. It's important to note that this proposal was previously submitted and refused by the planning panel on the basis of a R2 rezoning concept that would have resulted in complete removal of vegetation from the entire site.

The Planning Panel however gave support in principle for a revised rezoning concept that conserved the south-eastern portion of the site and the R2 zone would be retained on the western side of the current electrical easement. This was a direct avoidance action that recognised that the more diverse vegetation within the currently retained E3 zoned land would be conserved and restored. The current rezoning proposal has carried forward that avoidance action.

The recent inspection of the site revealed that the retained E3 land had low species diversity most likely due to dry conditions, grazing and past management. However, the retained E3 lands has a greater ability to regenerate due to higher species diversity, its sited closer to remnant vegetation to assist with regeneration and is located in lower and wetter ground conditions. The adjoining lots to the south also supports this view due to the presence of a dense understorey or more diverse species composition which we expect would regenerate well within low lying portions of the site.

The total area of Cumberland Plain Woodland vegetation within the site covers 8.35ha but in a highly-degraded condition. The past land management practice within the entire site which has extended over a decade has resulted in a low resilience land placed within portions of the site with low resilience, the E3 zone has conserved degraded vegetation that can be significantly improved, provides a linking parcel of vegetation to surrounding lots and will restore over a shorter time period.

The current proposal avoids impacting 3.74 ha of degraded CPW vegetation. The impacted CPW vegetation is of low quality, has low species diversity and would also be expected to regenerate poorly. Past management of this site which has extended over a decade based on aerial photography which has resulted in the low condition of the vegetation on the land.

Further avoidance of impact has been achieved through the removal of the proposed basin into the electrical easement and the creation of a small R2 parcel for a future dwelling on the northern boundary of the eastern portion of the site not within the centre of the of the retained E3 lands. This creates a less fragmented landscape and potential for a better conservation outcome.

Consequently, this flora and fauna assessment has assessed the avoidance of impact on the western lot and has assessed the impact on the eastern most portion which is proposed as a R2 Residential zone consistent with the adjoining residential lands to the north and west of the site.

Suitability of the proposed zones

The proposed zoning concept is supported by this ecological assessment on the basis of the following points:

- The existing vegetation within the proposed R2 zone has low resilience, low species diversity and the restoration effort would not result in a fully structured CPW vegetation without significant works over an extended 10 years or more. It also immediately abuts an existing residential zone and results in a reasonable extension of the R2 zone into a highly-degraded portion of the site.
- The loss of highly degraded CPW which currently contains sparse to moderate canopy with low species diversity is not significantly impacted by the proposed zoning and retains a significant portion of the existing more suitable land within the retained E3 zone.
- The proposed land to be retained under E3 environmental management has an ability to regenerate and can be restored over a shorter timeframe and forms part of larger more extensive parcel of vegetated lands.
- The proposed R2 lands would be required to be offset under the Biodiversity Offset Scheme at the time of a subdivision application and the retained E3 lands would contribute to that offset.
- Biodiversity offsetting of the impacted vegetation would result in a significantly better ecological outcome then trying to retain a highly-degraded portion of land.
- The proposed E3 lands can be required to be conserved, restored and protected in perpetuity by conditions of approval or a voluntary planning agreement.

Recorded threatened flora, fauna & EECs

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995*, four (4) threatened fauna species including Greater Broad-nosed Bat (*Scoteanax rueppellii*), Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), no threatened flora species and one (1) critically endangered ecological community (CEEC), Cumberland Plain Woodland, were recorded within the study area.

The Yellow-bellied Sheathtail-bat was recorded only to a 'probable' level of certainty however this species as well as the Eastern Bentwing-bat and the East-coast Freetail Bat (*Micronomus norfolkensis*) were recorded during previous site surveys by *Gunninah* (2015).

In accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*, the 7-part test of significance concluded that the proposed subdivision development will not likely have a significant impact on any threatened species, populations or EECs. Therefore, a Species Impact Statement is not required for the proposal.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, no threatened fauna species, no protected migratory bird species, no threatened flora species, and no EEC under this Act were recorded within the study area. The proposed vegetation removal was not considered to have a significant impact on matters of national environmental significance as the remnant vegetation present which is being impacted is not considered to meet the condition criteria to be commensurate with *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*. Offsetting of the biodiversity impacts is recommended to ensure a '*maintain or improve'* outcome is achieved. As such a referral to Department of Environment and Energy is not required.

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

The direct, indirect and cumulative impacts of the proposal have been carefully considered in Section 5.2 of this report.

Recommended mitigation and amelioration measures to the above mentioned impacts are, where applicable, addressed within Section 5.3 of this report. Biodiversity offsetting is recommended for all residual impacts estimated at 4.61 ha of Cumberland Plain Woodland consisting of 1.2 ha of low quality sparse canopy and 3.41ha of low quality moderate canopy areas. Both areas meet the definition of Cumberland Plain Woodland, its low quality results in a not significant impact. The proposed rezoning provides an opportunity to not only conserve a significant portion of the site under a VPA but also to create an offset within the locality and or on other lands within the locality.

Conclusion

It is concluded that the proposed vegetation removal within Lot 71 DP 706546, 71 St Andrews Road, Varroville, is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats.

The proposed zonings are also suitable for the site in terms of its current condition and the ability of the zoning to result in a positive ecological outcome for the site. Offsetting under the Biodiversity Offsets Scheme also results in a better conservation outcome on lands that can be conserved with a higher level of resilience.

As such no further assessments are considered to be required under the *Environmental Planning and Assessment Act 1979*, the *Environment Protection and Biodiversity Conservation Act 1999* or the *Fisheries Management Act 1994*.

List of abbreviations

AOBV	Area of Outstanding Biodiversity Value
APZ	asset protection zone
BAAS	Biodiversity Assessors Accreditation System
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Calculator
BAR	Biodiversity Assessment Report
BC Act	Biodiversity Conservation Act (2016)
BCAR	Biodiversity Certification Assessment Report
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOPC	Biodiversity Offsets Payment Calculator
BOS	Biodiversity Offset Scheme
BOSET	Biodiversity Offsets Scheme Entry Tool
BPA	bushfire protection assessment
BSA	Biodiversity Stewardship site Agreement
BSSAR	Biodiversity Stewardship Site Assessment Report
CLUMP	conservation land use management plan
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 (replaces SEWPAC)
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act (1979)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act (1999)*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act*
FMP	fuel management plan
HTA	habitat tree assessment
IBRA	Interim Biogeographic Regionalisation for Australia
IPA	inner protection area
LEP	Local Environment Plan
LGA	local government area
LLS Act	*Local Land Services Act (2013*)
NES	national environmental significance
NPW Act	*National Parks and Wildlife Act (1974)*

NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage
OPA	outer protection area
PBP	*Planning for bushfire protection 2006*
PCT	Plant Community Type
POM	plan of management
RF Act	*Rural Fires Act*
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SAII	Serious and Irreversible Impacts
SEARs	*Secretary's Environmental Assessment Requirements*
SEPP	State Environmental Planning Policy
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*
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
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act (1995)– Now replaced by the Biodiversity Conservation Act (2016)*
VMP	vegetation management plan

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Introduction 1

Travers bushfire & ecology has been engaged to undertake an updated flora and fauna assessment for a proposed rezoning within Lot 71 DP 706546, 71 St Andrews Road, Varroville. The entire area of this lot has been subject to flora and fauna survey effort and will hereafter be referred to as the 'study area'. In some circumstances survey has however extended slightly beyond this boundary.

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions
- Carry out a fauna survey for the detection and assessment of fauna and their habitats
- Complete target surveys for threatened species, populations and ecological communities
- Prepare a flora and fauna impact assessment in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Threatened Species Conservation Act 1995* (*TSC Act*), the *Fisheries Management Act 1994* (FM Act) and Threatened species assessment guidelines, the assessment of significance (DECC 2007)

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act 1995 (TSC Act)

The specific requirements of the *TSC Act* must be addressed in the assessment of impacts on threatened flora and fauna, populations and ecological communities. The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and are based on a 7-part test of significance. 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, a Species Impact Statement (SIS) is required to be prepared.

1.2.2 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.

1.2.3 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 Environment and Energy (DoEE) 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 apply 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 1999 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.

1.3 Proposal

The study area is currently zoned E3 Environmental Management. The proposal is for the rezoning of the lands to the north-western side of the powerline easement and subsequent subdivision. The proponents are intending to offset the impacts through a Bio-Banking Application as it has been considered under transitional provisions of the *TSC Act*.

The remaining E3 lands on the south-eastern side of the powerline easement are likely to have in the future either a restriction of the use of that title under an 88B Instrument or a conservation agreement of some form which may or may not include a Biodiversity Stewardship Agreement under the *BC Act*.

Future works within the E3 lands will also include a single dwelling with associated works and APZ, and a stormwater detention basin.

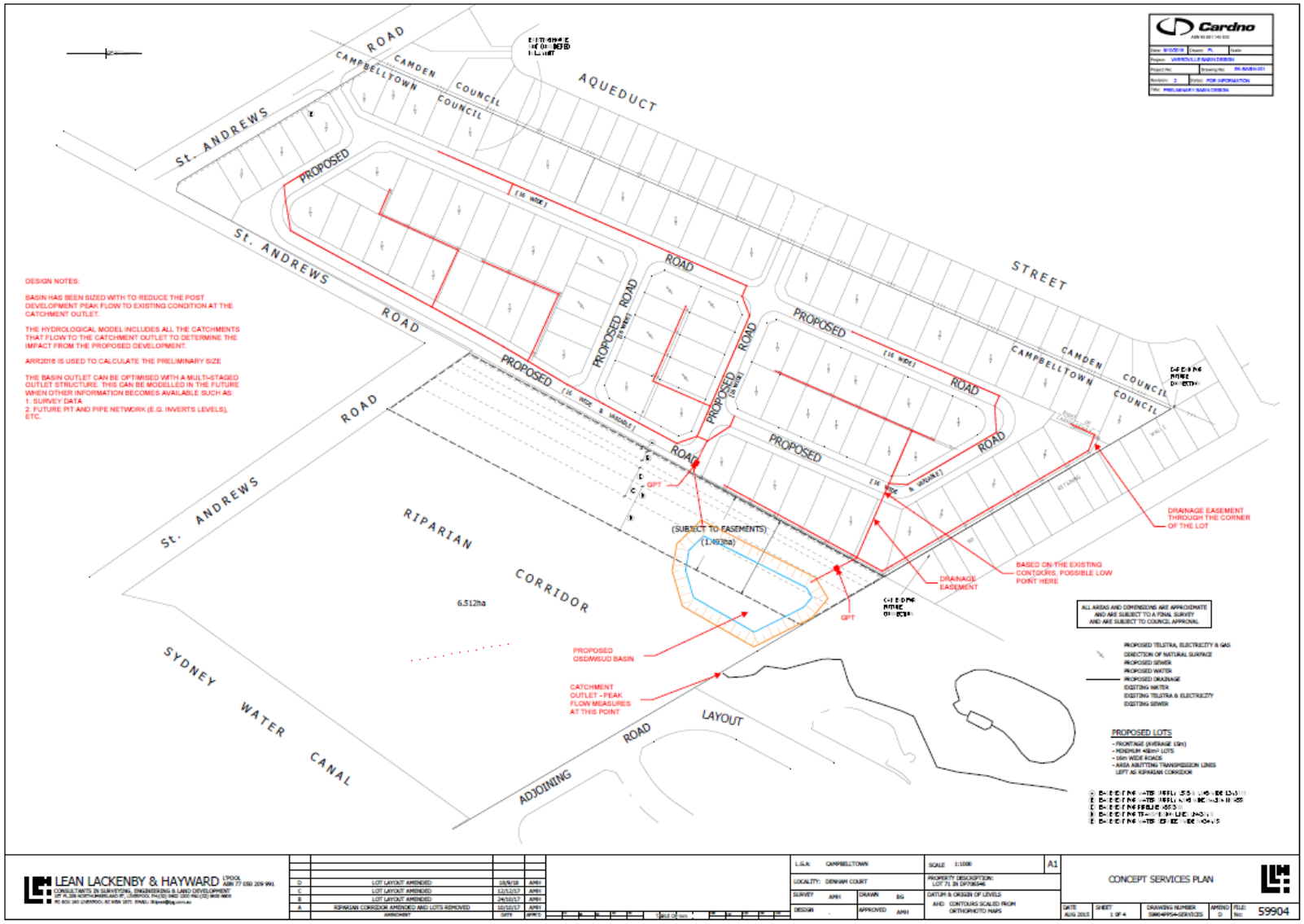


Figure 1 – Concept services plan

1.4 Site description

Table 1.1 provides a summary of the planning, cadastral, topographical, and disturbance details of the site.

The area of the site is approximately 14 ha with an electrical easement bisecting the site.

Table 1.1 – Site features

Location	71 St Andrews Road, Varroville Lot 71 DP706546
Local government area	Campbelltown
Grid reference	297400E 6237200N
Elevation	100m AHD +/- 5m
Topography	Situated on a mostly flat landscape with a very gentle rise to the south-east of the site along Andrews Road.
Geology and soils	Geology; Wianamatta Group, Bringelly Shale – Shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.
Catchment and drainage	Catchment – Georges River, Sydney Metro CMA. There are no creeks or drainage lines within the study area.
Vegetation	Where present, native vegetation has an open woodland structure. Trees are around 15-25m tall in most areas, there is a limited mid-storey or nil, and a ground layer of grasses and forbs. The vegetation is modified throughout the study area due to previous clearing and continued grazing and cultivation processes.
Existing land use	Cattle grazing/managed
Clearing	The understorey has been previously cleared for indicated land uses.
Zoning	E3 – Environmental management

Survey Methodology 2

2.1 Information collation, technical resources, desktop assessments, specialist identification and licences

A review of the relevant information pertinent to the subject site was undertaken.

Standard technical resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- Aerial photographs (Google Earth Pro / Spatial Information Exchange / NearMap)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act 1995* (*TSC Act*)
- *Biodiversity Conservation Act 2016* (BC Act)
- *Fisheries Management Act 1994* (FM Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Rare or Threatened Australian Plants (ROTAP)
- Vegetation mapping - Vegetation Mapping of the Cumberland Plain (NPWS 2002) and Sydney Metropolitan Catchment Management Authority (OEH 2013).

Desktop assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site, desktop assessments were undertaken including:

- ***A literature review*** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.

- ***A data search*** – A search of the *Atlas of NSW Wildlife* (OEH 2017 and 2018) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. Searches were also undertaken on the DOEE – 'protected matters search tool' website to generate a report that will help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in the area of interest. The search was broadened to a 10km radius like the Atlas search. These two searches combined, enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

Accuracy of identification:

Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to Specht *et al* (1995).

***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 Department of Agriculture. 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.

2.2 Flora survey methodology

Flora survey was undertaken on the 3rd of November 2017 and 21st of November 2018. A random meander search was undertaken in accordance with Cropper (1993) to create a broad species list. Whilst some landscaping species were noted and identified during the random meander searches, no specific survey was undertaken for these species (most of which will not appear on the species list in section 3), in particular around the access driveway and existing dwelling.

Five (5) 20x20m and 50x20m transect plots were undertaken in accordance with the Biodiversity Assessment Methodology (BAM), 2017. However, given that raking of the understorey had been undertaken prior to the November 2017 survey an updated floristic assessment was undertaken in November 2018 after the site had been spelled for 7-9 months and at least one significant rainfall event. An additional five (5) 20x20m and 50x20m transect plots were undertaken for the purposes of remapping the vegetation within the lot.

A review of the Atlas of NSW Wildlife, Bionet (OEH 2017) was undertaken prior to the botanical survey to identify threatened species previously recorded within 10km of the subject site and determine whether target searches were needed to be undertaken. Target searches for relevant threatened species were undertaken where applicable during the random meander, whilst undertaking plot transects, and additionally as stratified surveys that typically involve searching for the relevant species in linear lines at intervals of approximately 10-15m apart. An updated Bionet search was undertaken in 2018 to see if there were any new listings of threatened species that may require consideration.

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 3.

Current standard fauna survey techniques employed by *Travers bushfire & ecology* in line with relevant survey guidelines as well as current survey knowledge are provided in Appendix 1. Fauna survey techniques that have been tailored to the site are provided in Section 2.5.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
Diurnal birds	31/10/17	3/8 cloud, light-mod SW wind, no rain, temp 18ºC	Diurnal opportunistic	1hr 5min 1050 - 1155
	2/11/17	4/8 cloud, light N wind, no rain, temp 23-18ºC	Diurnal opportunistic	6hrs 1300 - 1900
Nocturnal birds	2/11/17	7/8 cloud, light ESE wind, no rain, temp 18-17ºC	Spotlighting	2hrs 1930 - 2130
			Call playback (Powerful Owl)	Commenced @ 2000
Arboreal mammals	2/11/17	7/8 cloud, light ESE wind, no rain, temp 18-17ºC	Spotlighting	2hrs 1930 - 2130
Terrestrial mammals	2/11/17	7/8 cloud, light ESE wind, no rain, temp 18-17ºC	Spotlighting	2hrs 1930 - 2130
Bats	2/11/17	7/8 cloud, light ESE wind, no rain, temp 18-17ºC	Spotlighting	2hrs 1930 - 2130
			Ultrasonic recording (passive monitoring) x3	Overnight from 1920
Reptiles	31/10/17	3/8 cloud, light-mod SW wind, no rain, temp 18ºC	Habitat search, opportunistic	1hr 5min 1050 - 1155
	2/11/17	4/8 cloud, light N wind, no rain, temp 23-18ºC	Habitat search, opportunistic	6hrs 1300 - 1900
Amphibians	2/11/17	7/8 cloud, light ESE wind, no rain, temp 18-17ºC	Spotlighting & call identification	2hrs 1930 - 2130
Molluscs	31/10/17	3/8 cloud, light-mod SW wind, no rain, temp 18ºC	Habitat searches	1hr 5min 1050 - 1155
	2/11/17	4/8 cloud, light N wind, no rain, temp 23-18ºC	Habitat searches	6hrs 1300 - 1900

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities – field verification and aerial photographic interpretation	3/11/17
Stratified sampling	BAM quadrats	3/11/17
Target searches	Target searches in known habitats, primarily for *Pimelea spicata*	3/11/17

2.5 Site specific survey techniques

Diurnal birds

Three (3) diurnal bird census points were undertaken within the study area. A minimum of 30 minutes of survey was undertaken at each census point in an area radiating out to between 80-100m. Bird census points were selected to give an even spread and representation across the site and its communities (see Figure 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.

Nocturnal birds

Given the marginal suitability of habitat present Powerful Owl (*Ninox strenua*) was targeted by call-playback techniques.

Invertebrates

Given the proximity to previous Atlas of NSW Wildlife records of Cumberland Plain Land Snail (*Meridolum corneovirens*) and the recorded presence of its typical host community, target surveys were undertaken. Habitat searches were undertaken within areas indicated on Figure 2. Within search areas the most appropriate areas of observed habitat were targeted. Dense areas of leaf litter with likely moisture retaining properties were scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks were also turned over.

Habitat trees

Hollow-bearing trees were identified and recorded within the subject site on a *Trimble* handheld GPS unit during surveys. All data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height were collected and a metal tag with the tree number placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging were also noted.

A summary of hollow-bearing tree results is provided in Table 4.3.

2.6 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site 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 subject site 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 garden / landscaping species and those species which could not be identified at the time of the survey past genus level.

Given that ploughing had been recently undertaken, the number of observed species might be lower than normal. Additional species listed in the report by Gunninah has been included and noted in the species list, Table 3.1.

It is not expected that there are any limitations to threatened flora species survey which could change the outcomes of significance assessment.

Fauna survey limitations

Seven hollow-bearing trees were identified within the study area. Some of the hollows are suitable for microbats, notably the recorded threatened hollow-dependent Large-Footed Myotis, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat. Also the East-coast Freetail Bat recorded during previous site survey by Gunninah (2015).

Stag-watching of each of the identified hollows has not been undertaken and is recommended within any proposed development areas. Any identified threatened microbat roost should be retained in-situ as the removal of such a roost would be considered significant impact on the respective local populations.

Survey Results 3

3.1 Flora results

3.1.1 Flora species

The plants observed within the vegetation communities of the subject site are listed in the Table 3.1 below.

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name	Species recorded by Gunninah only (2015)
Trees			
Mimosaceae	*Acacia decurrens*	Black Wattle	
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum	✓
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	
Myrtaceae	*Eucalyptus fibrosa*	Broad Leaved Ironbark	
Myrtaceae	*Eucalyptus longifolia*	Woollybutt	✓
Myrtaceae	*Eucalyptus moluccana*	Grey Box	
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	
Santalaceae	*Exocarpos cupressiformis*	Native Cherry	
Myrtaceae	*Melaleuca decora*	-	
Shrubs			
Mimosaceae	*Acacia ulicifolia*	Prickly Moses	
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush	
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Native Blackthorn	
Faboideae	*Chorizema parviflorum*	Eastern Flame Pea	✓
Fabaceae	*Dillwynia sieberi*	Prickly Parrot-pea	
Apocnynaceae	*Gomphocarpus fruticosus**	Narrow Leaf Cotton Bush	
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive	
Rubiaceae	*Opercularia diphylla*	-	✓
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood	
Groundcovers			
Lamiaceae	*Ajuga australis*	Austral Bugle	✓
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	
Asteraceae	*Arctotheca calendula**	Capeweed	
Poaceae	*Aristida vagans*	Three-awn Speargrass	
Poaceae	*Avena fatua**	Wild Oats	
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass	

Family	Scientific name	Common name	Species recorded by Gunninah only (2015)
Poaceae	*Bothriochloa decipiens*	Redleg Grass	✓
Poaceae	*Bothriochloa macra*	-	✓
Brassicaceae	*Brassica oleracea**	Cauliflower	✓
Poaceae	*Briza minor**	Shivery Grass	
Poaceae	*Briza subaristata**	-	
Poaceae	*Bromus cartharticus**	Prairie Grass	✓
Acanthaceae	*Brunoniella australis*	Blue Trumpet	
Crassulaceae	*Bryophyllum pinnatum**	-	✓
Brassicaceae	*Capsella bursa-pastoris**	Shepherds purse	
Cyperaceae	*Carex inversa*	Knob Sedge	
Apiaceae	*Centella asiatica*	Indian Pennywort	
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed	✓
Sinopteridaceae	*Cheilanthes sieberi*	Rock Fern	
Poaceae	*Chloris truncata*	Windmill Grass	
Poaceae	*Chloris ventricosa*	Tall Chloris	
Asteraceae	*Cirsium vulgare**	Spear Thistle	
Asteraceae	*Conyza sumatrensis**	Fleabane	
Asteraceae	*Cotula australis*	Common Cotula	
Asteraceae	*Cymbonotus lawsonianus*	Bears-ear	
Poaceae	*Cynodon dactylon*	Common Couch	
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge	
Cyperaceae	*Cyperus gracilis*	-	✓
Alismataceae	*Damasonium minus*	Starfruit	
Solanaceae	*Datura stramonium**	Common Thornapple	✓
Phormiaceae	*Dianella longifolia*	-	
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass	✓
Convolvulaceae	*Dichondra repens*	Kidney Weed	
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass	
Poaceae	*Ehrharta erecta**	Panic Veldtgrass	
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	✓
Chenopodiaceae	*Einadia polygonoides*	-	
Chenopodiaceae	*Einadia trigonos* subsp. *trigonos*	Fishweed	
Cyperaceae	*Eleocharis cylindrostachys*	-	
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush	
Poaceae	*Entolasia marginata*	Bordered Panic	
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	
Poaceae	*Eragrostis curvula**	African Lovegrass	
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	✓
Asteraceae	*Euchiton sphaericus*	-	
Euphorbiaceae	*Euphorbia peplus**	Spurge	
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-rush	
Asteraceae	*Gamochaeta purpurea**	Purple Cudweed	✓
Geraniaceae	*Geranium homeanum*	Northern Cranesbill	
Boraginaceae	*Heliotropium amplexicaule**	Blue Heliotrope	
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort	✓

Family	Scientific name	Common name	Species recorded by Gunninah only (2015)
Asteraceae	*Hypochaeris radicata**	Flatweed	
Juncaceae	*Juncus subsecundus*	Finger Rush	✓
Juncaceae	*Juncus usitatus*	Common Rush	
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily	
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush	✓
Fabaceae	*Lotus subbiflorus**	Hairy Birds-foot Trefoil	
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose	
Primulaceae	*Lysmiachia arvensis**	Scarlet Pimpernel	
Malvaceae	*Malva parviflora**	Small-flowered Mallow	✓
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass	
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow	
Poaceae	*Oplismenus aemulus*	Basket Grass	
Hydrocharitaceae	*Ottelia ovalifolia*	Swamp Lily	
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel	
Oxalidaceae	*Oxalis perennans*	-	
Poaceae	*Panicum simile*	Two Colour Panic	
Poaceae	*Paspalidium distans*	-	
Poaceae	*Paspalum dilatatum**	Paspalum	✓
Poaceae	*Paspalum distichum*	Water Couch	
Poaceae	*Paspalum urvillei**	Vasey Grass	
Poaceae	*Pennisetum clandestinum**	Kikuyu	
Philydraceae	*Philydrum lanuginosum*	Frogmouth	
Plantaginaceae	*Plantago debilis*	Slender Plantain	✓
Plantaginaceae	*Plantago lanceolata**	Ribwort	
Plantaginaceae	*Plantago myosurus**	-	✓
Poaceae	*Poa annua**	Winter Grass	✓
Potamogetonaceae	*Potamogeton tricarinatus*	Pondweed	✓
Lobeliaceae	*Pratia purpurascens*	Whiteroot	
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	
Rubiaceae	*Richardia stellaris**	-	✓
Brassicaceae	*Rorippa nasturtium-aquaticum*	Watercress	✓
Poaceae	*Rytidosperma pilosum*	Smooth-flower Wallaby Grass	
Poaceea	*Rytidosperma racemosum*	-	✓
Asteraceae	*Senecio madagascariensis**	Fireweed	
Poaceae	*Setaria parviflora**	-	
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne	
Solanaceae	*Solanum chenopodioides**	Whitetip Nightshade	✓
Solanaceae	*Solanum nigrum**	Black Nightshade	
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	
Asteraceae	*Soliva sessilis**	Jojo	
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle	
Poaceae	*Sporobolus africanus**	Parramatta Grass	
Stackhousiaceae	*Stackhousia viminea*	-	
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass	
Asteraceae	*Taraxacum officinale**	Dandelion	

Family	Scientific name	Common name	Species recorded by Gunninah only (2015)
Poaceae	*Themeda triandra*	Kangaroo Grass	
Juncaginaceae	*Triglochin microtuberosum*	Water Ribbons	
Verbenaceae	*Verbena bonariensis**	Purpletop	
Verbenaceae	*Verbena rigida**	Veined Verbena	
Plantaginaceae	*Veronica persica**	Creeping Speedwell	✓
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell	
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell	
Colchicaceae	*Wurmbea dioica* subsp. *dioica*	Early Nancy	✓
Vines			
Apocnyaceae	*Araujia sericifera**	Mothvine	
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper	
Fabaceae	*Desmodium varians*	-	
Fabaceae	*Glycine clandestina*	Twining Glycine	
Fabaceae	*Glycine tabacina*	Variable Glycine	
Epiphytes			
Loranthaceae	*Amyema pendula*	Mistletoe	
*** denotes exotic species**			

3.1.2 Vegetation communities

One (1) natural remnant vegetation community was identified within the subject site through ground truthing. The remainder of the site is managed or ploughed with planted species around the existing dwelling.

- Cumberland Plain Woodland

Cumberland Plain Woodland

The structure of the community is a woodland or open woodland, 15-24m in height and with a projected foliage cover of 12-25%. The most common canopy species are *Eucalyptus moluccana, Eucalyptus tereticornis* and *Eucalyptus fibrosa.* Canopy density varies from moderate to sparse (see Figure 2).

The mid-storey is almost absent, however slashed specimens of *Bursaria spinosa* are persistent, generally in the ground layer. There may be a few shrubs present along the site boundary which are not regularly slashed. *Melaleuca decora,* a small tree, is present on site, mostly along the central easement area and within Quadrat 5. Other slashed shrubs that were regular include *Acacia ulicifolia, Dillwynia sieberi, Breynia oblongifolia* and *Ozothamnus diosmifolius.*

The ground layer of vegetation is regularly ploughed or slashed. The western half has been recently ploughed before the site survey, north of the dwelling and shed. Grazing was occurring in close proximity to the dwelling (immediately east). Ploughing or slashing had been undertaken in the eastern half of the site but the ground layer was less disturbed at the time of the site survey.

Common groundcovers include *Aristida vagans, Brunoniella australis, Centella asiatica, Dichondra repens, Echinopogon caespitosus, Einadia* spp., *Eragrostis brownii, Geranium homeanum, Glycine clandestina, Microlaena stipoides, Oxalis perennans, Panicum simile, Pratia purpurascens, Rytidosperma* spp., *Stackhousia viminea* and *Wahlenbergia gracilis.*

In relation to BioBanking and the Biodiversity Assessment Methodology (BAM), the vegetation type is equivalent to PCT849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

This community occupies 8.35 ha throughout the site. The western half has more gaps at present due to a lack of native ground layer having been recently ploughed, while the eastern half is more intact.





Photo 1 – 5, left to right, centre line through quadrat 1 to quadrat 5. Note the heavily disturbed and almost absent ground layer due to raking. (November 2017)

Photo 6 – Slashed groundlayer in the centre of the eastern portion of the site (November 2017)

Photo 7 – Raked groundlayer in the centre of the western portion of the site looking towards the existing house and shed (November 2017)

Photo 8 - Raked ground layer in the cleared areas after extensive dry period - centre of the western portion of the site looking towards the existing house and shed (November 2018)

Other vegetation

There are three (3) dams on site, some with fringing macrophytes. Some common species within the dam or on the embankment include *Elaeocarpus* spp*., Juncus* spp., *Ludwigia peploides, Paspalum distichum, Philydrum lanuginosum* and *Triglochin microtuberosum.*

Photo 9 – Dam adjacent to the northern boundary in eastern portion of the site (November 2017)

Photo 9 – Dam near northern boundary in western portion of the site (November 2017)

Planted vegetation occurs adjacent to the site entrance up to and surrounding the existing dwelling. Photo 10 shows an example along the access driveway.

Photo 10 – Planted vegetation along the access driveway (November 2017)

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.2 below.

Table 3.2 – Fauna observations for the study area

Common name	Scientific name	Method observed	
		Gunninah 2014-15	*TBE* Oct-Nov 2017
Birds			
Australian Magpie	*Cracticus tibicen*	✓	O W
Australian Raven	*Corvus coronoides*	✓	O W
Australian Wood Duck	*Chenonetta jubata*	✓	O
Bell Miner	*Manorina melanophrys*	✓	O W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	✓	O W
Collared Sparrowhawk	*Accipiter cirrhocephalus*		O
Common Myna *	*Sturnus tristis*	✓	
Crested Pigeon	*Ocyphaps lophotes*	✓	O
Eastern Rosella	*Platycercus eximius*	✓	O W
Galah	*Eolophus roseicapillus*	✓	O W
Grey Butcherbird	*Cracticus torquatus*	✓	O W
Grey Fantail	*Rhipidura albiscapa*	✓	O W
Intermediate Egret	*Ardea intermedia*		O
Laughing Kookaburra	*Dacelo novaeguineae*	✓	O
Magpie-lark	*Grallina cyanoleuca*	✓	O W
Masked Lapwing	*Vanellus miles*	✓	O W
Mistletoebird	*Dicaeum hirundinaceum*		O W
Noisy Friarbird	*Philemon corniculatus*	✓	O W
Noisy Miner	*Manorina melanocephala*	✓	O W
Olive-backed Oriole	*Oriolus sagittatus*		W
Pacific Black Duck	*Anas superciliosa*	✓	
Pallid Cuckoo	*Cacomantis pallidus*		W
Pied Butcherbird	*Cracticus nigrogularis*		O
Pied Cormorant	*Phalacrocorax varius*	✓	
Red-rumped Parrot	*Psephotus haematonotus*	✓	W
Red-whiskered Bulbul *	*Pycnonotus jocosus*		W
Rufous Whistler	*Pachycephala rufiventris*		W
Scarlet Honeyeater	*Myzomela sanguinolenta*		O W
Spotted Pardalote	*Pardalotus punctatus*	✓	W
Striated Thornbill	*Acanthiza lineata*		
Sulphur Crested Cockatoo	*Cacatua galerita*		O W
Superb Fairy-wren	*Malurus cyaneus*		W
Welcome Swallow	*Hirundo neoxena*		O
White-browed Scrubwren	*Sericornis frontalis*		O W
White-faced Heron	*Egretta novaehollandiae*		O
White-necked Heron	*Ardea pacifica*	✓	
White-throated Gerygone	*Gerygone olivacea*		W
Willie Wagtail	*Rhipidura leucophrys*	✓	O W
Yellow-faced Honeyeater	*Caligavis chrysops*	✓	W
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	✓	
Mammals			
Cat (feral)*	*Felis catus*	✓	

Common name	Scientific name	Method observed	
Chocolate Wattled Bat	*Chalinolobus morio*	✓	U[PO]
Common Brushtail Possum	*Trichosurus vulpecula*	✓	
Domesticated Cattle *	*Bos taurus*	✓	O
Domesticated Dog *	*Canis lupus familiaris*	✓	O
East-coast Freetail Bat [TS]	*Micronomus norfolkensis*	✓	
Eastern Bentwing-bat [TS]	*Miniopterus orianae oceanensis*	✓	U
Eastern Freetail-bat	*Mormopterus ridei*		U
European Red Fox *	*Vulpes vulpes*	✓	O
Forest Bat	*Vespadelus sp*	✓	U
Gould's Wattled Bat	*Chalinolobus gouldii*	✓	U
Greater Broad-nosed Bat [TS]	*Scoteanax rueppellii*		U
Large-footed Myotis [TS]	*Myotis macropus*		U
Rabbit *	*Oryctolagus cuniculus*	✓	O
White-striped Mastiff-bat	*Austronomus australis*		U
Yellow-bellied Sheathtail-bat [TS]	*Saccolaimus flaviventris*	✓	U[PR]
Reptiles			
Bar-sided Skink	*Eulamprus tenius*		O
Delicate Skink	*Lampropholis delicata*	✓	O
Eastern Water Dragon	*Intellagama lesueurii*	✓	
Weasel Skink	*Saproscincus mustelinus*	✓	
Amphibians			
Common Eastern Froglet	*Crinia signifera*	✓	W
Whistling Tree Frog	*Litoria verreauxii*	✓	

Note: * indicates introduced species
[TS] indicates threatened 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


tation to the north-west
trical easement = 4.2 ha
Proposed
detention
basin
HT1
Q1
HT2
Q6
GBB
HT4
Q2
Q7
Q8
LFM
YBSB
Q3
HT6
Q10
EBB
HT7
HT3
Q4
Q5
HT5
Q9

Ecological Assessment 4

4.1 Previous surveys reviewed

Gunninah (2015) undertook a previous ecological assessment for the study area from site visits in 2014 and 2015 for a previous planning proposal. The species records have been considered and incorporated into this report where appropriate.

The following regional vegetation mapping was examined to identify the potential vegetation communities onsite.

Native Vegetation Mapping of the Cumberland Plain (National Parks and Wildlife Service 2002).

The Vegetation Mapping of the Cumberland Plain (National Parks and Wildlife Service 2002) identified the vegetation as Map Unit 10 – Shale Plains Woodland.

Native Vegetation of the Sydney Metropolitan Catchment Management Area (OEH 2013).

The study area is approximately 500m outside of the Sydney Metropolitan CMA, instead within the Hawkesbury-Nepean. The mapping nearest the site suggests it is likely to be PCT 849 or PCT 850, both of which are derivatives of the Cumberland Plain Woodland community, listed under the *TSC Act* as critically endangered, and potentially Shale Gravel Transition Forest as critically endangered under the EPBC Act dependent upon size and quality criteria.

4.2 Flora

No threatened flora species were observed.

The ploughing within the western portion of the site would greatly reduce the likelihood of potential habitat for all threatened flora species that may occur. Due to this disturbance of the soil, it was expected that threatened flora were unlikely to be found. The habitat potential in the eastern portion was quite limited within the central parts, but possibly better quality along the boundary fences where the vegetation was not regularly slashed or mown. Linear transects in a zig zag pattern were undertaken across parts of the eastern portion of the site but no threatened species were observed.

All flora species observed within the study area are listed in Table 3.1.

4.2.1 Local / Regional flora matters

The following species occur within the site and are considered to have some local value within the Campbelltown LGA, however none are listed as regionally significant as they have a widespread distribution across the Cumberland Plain of Sydney:

- *Euchiton sphaericus*

- *Oxalis perennans*

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2018) 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 A2.1 (Appendix 2).

Based on the habitat assessment within Appendix 2, it is considered that the subject site 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	*TSC Act*	Potential to occur	Potential impact
Pimelea spicata	E1	✓	Direct – on potential habitat only

Note: Full habitat descriptions for these species are provided in Appendix 2

Other species were considered to have low or marginal potential habitat but were ruled out due to previous pasture improvement and ongoing ploughing or slashing of the ground layer of vegetation.

No state listed threatened flora species were observed during survey(s) undertaken. These species have been assessed in detail within Appendix 3.

(b) Endangered flora populations (NSW)

There is one (1) known endangered population within the Campbelltown LGA: *Marsdenia viridiflora* subsp. *viridiflora*.

There are no close recordings of the species. Potential habitat was heavily degraded by prior slashing and the study area is not suitable any longer.

This population is not represented within the study area.

(c) Threatened ecological communities (NSW)

One (1) critically endangered ecological community (CEEC) – Cumberland Plain Woodland – was observed within the subject site;

- Cumberland Plain Woodland

8.35 ha of Cumberland Plain Woodland occurs within the study area.

The proposed vegetation clearing within the western portion would likely impact 4.61ha of poor quality Cumberland Plain Woodland. The eastern portion zoned E3 would see retention of CPW vegetation in a protected lot and result in a restoration outcome of an estimated 4.71ha. Additional offsetting to achieve a maintain or improve outcome may be required in accordance with the BAM methodology.

This community has been assessed in detail within Appendix 3.

4.2.3 Endangered wetland communities

A number of wetland communities have been listed as an 'endangered ecological community' under the NSW *TSC / BC Act*. We note that 'wetlands' are included in the definition of 'waterfront lands' in accordance with the Water Management Act 2000 due to their inclusion in the definition of a 'lake' under the same act.

Impacts on wetland communities must be assessed under the *TSC Act / BC Act* and if present the management of wetland communities must be given due consideration in accordance with the objectives and principles of management as contained within the NSW Wetlands Policy (2010), and appropriate management as determined by NSW DPI - Office of Water in their general terms of approval (GTA's). This may include but not limited to the provision of buffers, management of stormwater runoff and maintenance of natural inflows or runoff into those wetland communities.

- Artesian springs ecological community - endangered ecological community listing
- Castlereagh swamp woodland community - endangered ecological community listing
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Kurri sand swamp woodland in the Sydney Basin Bioregion - endangered ecological community listing
- Lagunaria swamp forest on Lord Howe Island - endangered ecological community listing
- Maroota Sands swamp forest - endangered ecological community listing
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion - endangered ecological community listing
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion - endangered ecological community listing
- The shorebird community occurring on the relict tidal delta sands at Taren Point - endangered ecological community listing
- Upland wetlands of the drainage divide of the New England Tableland Bioregion - endangered ecological community listing
- Wingecarribee Swamp

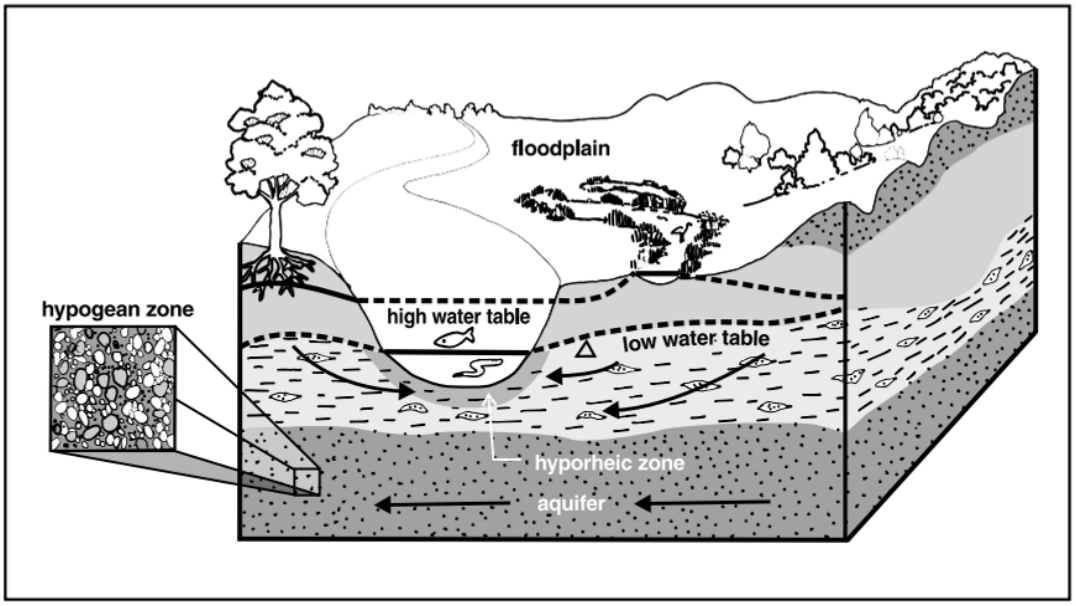
None of the aforementioned wetland communities are present within the study area, therefore they do not require any further consideration.

In accordance with the NSW DPI - Office of Water - Guidelines for Controlled Activities a standardised buffer of 40m applies to endangered wetland communities subject to offset provisions. Where they are mostly cleared, highly fragmented or highly disturbed, consolidation and management in accordance with a Vegetation Management Plan is recommended. The buffers provided are to be considered in the landscape context and consultation with NSW DPI – WaterNSW (formerly NSW Office of Water) shall be undertaken to confirm the appropriateness of setbacks.

4.2.4 Groundwater dependent ecosystems (GDEs)

Groundwater dependent ecosystems 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.



Alluvial groundwater system discharging into a river

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

There are no GDE's present within the study area, therefore further consideration of GDEs is not required.

4.2.5 Matters of national environmental significance - flora

(a) Threatened flora species (national)

A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10km radius of the site. These species have been considered for the presence of suitable habitat and potential to occur within Appendix 2.1.

Based on the habitat assessment within Appendix 2.1, it is considered that the subject site 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	Potential impact
Pimelea spicata	E	✓	Direct – on potential habitat only

One (1) nationally listed threatened flora species, *Pimelea spicata,* has the potential to occur as there is suitable habitat within the study area. Despite detailed targeted searches, this species was not observed within the study area.

(b) Endangered ecological communities (national)

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest is the equivalent critically endangered ecological community under the *EPBC Act* to Cumberland Plain Woodland under the *TSC Act*.

There are a number of criteria the vegetation must have in order to qualify for recognition under the *EPBC Act* which Figure 3 displays as a flowchart.

In each of the 10 quadrats, native groundcover does not exceed 30%. In comparison to the exotic or introduced species, native species made up much less than 30% of the groundcover We note that the Quadrat 6 – 4% native vegetation, Quadrat 7 - 2%, Quadrat 8 & 9 - 1%, Quadrat 10 – 18%. As such, the condition of the vegetation has been severely depleted such that it no longer can be considered under the *EPBC Act*.

A referral to DOEE under the *EPBC Act* will therefore not be required.

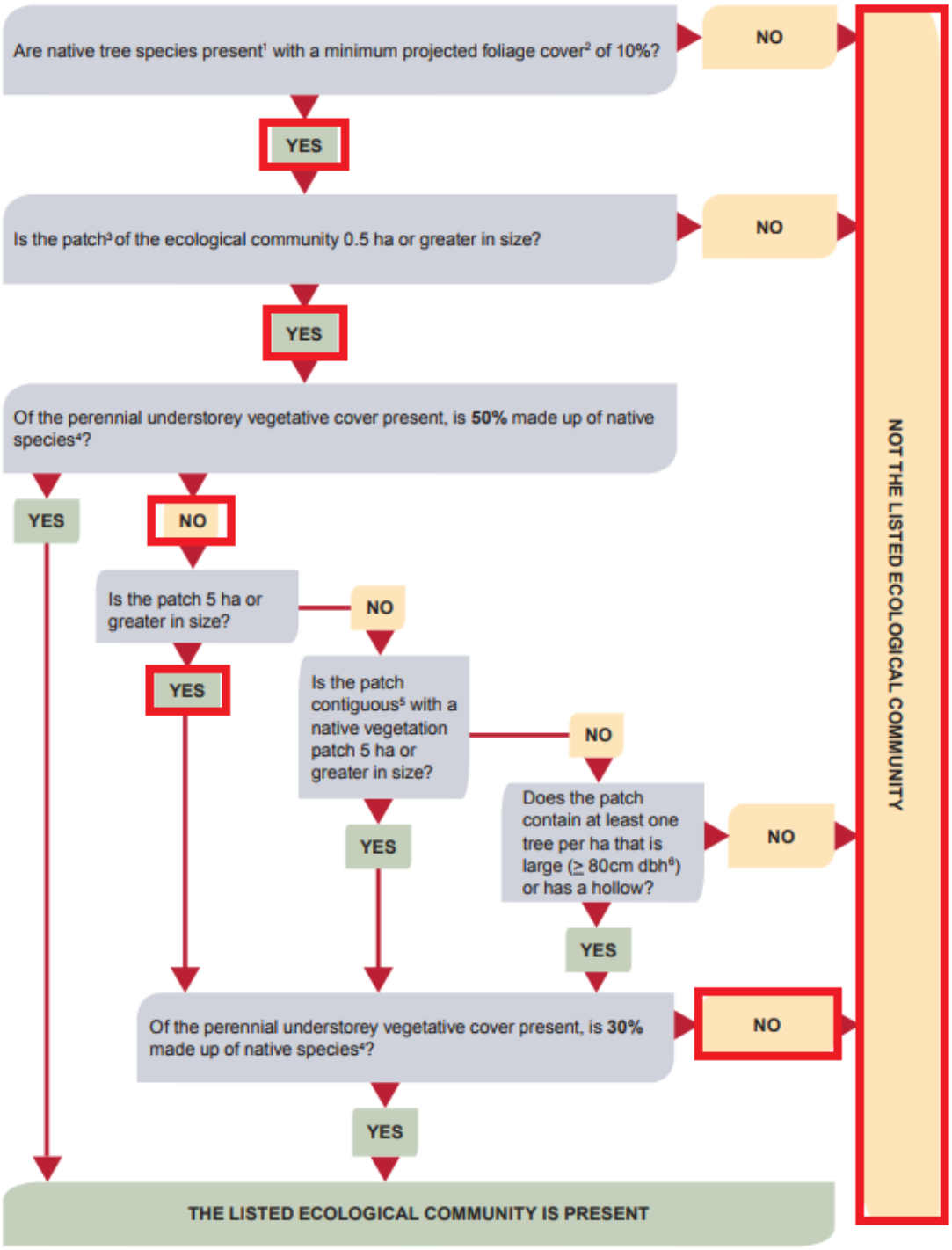


Figure 3 – Flowchart for determination of Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest

4.3 Fauna

All fauna species recorded during survey are listed in Table 3.2.

4.3.1 Fauna habitat

The fauna habitats present within the site are identified within Table 4.3.

Table 4.3 – 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				
No rock habitat present				
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	Pipe / culvert(s)		Tunnel(s)		Shaft(s)	
FOREIGN MATERIALS:	Sheet		Pile / refuse ✓			

4.3.2 Habitat trees

A complete assessment of the location of habitat trees and the size of hollows within was undertaken as part of surveys. Table 4.4 below provides hollow-bearing tree data and Figure 2 shows locations of habitat trees.

One large hollow was considered suitable in size for threatened owls but is not considered likely for use given its placement in a highly managed landscape. There are only records of Powerful Owl within 3km of the study area however there is no roosting opportunity for this species within the study area itself.

Three (3) hollow-dependent threatened fauna species were recorded present during survey including the Yellow-bellied Sheathtail-bat, Large-footed Myotis and the Greater Broad-nosed Bat. Hollows recorded present may be suitable for roosting and breeding by these species. The removal of a hollow roost within the landscape for any of these bats species would be regarded as a potential significant impact on a local population, given the limited selection of hollows by these local populations. Subsequent to the findings of suitable hollows, each of these will need to be checked for use prior to subdivision.

The recorded presence of a threatened microbat roost within the proposed R2 Residential area will require this to be retained. This may be undertaken ahead of any further planning to effectively advise the subdivision layout. There are only two hollow-bearing trees within this area so the potential for their use is not expected. Similarly the proposed E3 land has scope to contain a single dwelling and additional hollow-bearing trees within any proposed development footprint will be similarly constrained. Hence further survey is required to advise future layouts.

Table 4.4 – Habitat tree data

Tree No	Common Name	Scientific Name	DBH (cm)	Height (m)	Spread (m)	Vigour (%)	Hollows Recorded
HT1	Grey Box	*E moluccana*	42	18	8	75	1x 0-5cm branch
HT2	Rough-barked Apple	*A floribunda*	62	15	6	75	4x 0-5cm branch, 2x10-15cm branch spouts
HT3	Forest Red Gum	*E tereticornis*	105	23	13	85	1x 10-15cm trunk
HT4	Grey Box	*E moluccana*	125	19	6	70	1x 40-50cm low trunk
HT5	Broad-leaved Paperbark	*M quinquenervia*	80	19	6	80	1x 0-5cm trunk, 1x 0-5cm branch
HT6	Forest Red Gum	*E tereticornis*	160	21	13	80	1x 5-10cm branch, 1x 40-50cm broken trunk
HT7	Grey Box	*E moluccana*	70	19	7	70	3x 0-5cm branch,

Tree No	Common Name	Scientific Name	DBH (cm)	Height (m)	Spread (m)	Vigour (%)	Hollows Recorded
							1x 0-5cm branch spout, 2x10-15cm branch

4.3.3 Local fauna matters

No fauna species recorded present during survey are listed as a regionally significant species within the *Native Fauna of Western Sydney - Urban Bushland Biodiversity Survey* (NPWS 1997).

4.3.4 State legislative fauna matters

(a) Threatened fauna species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2018) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the subject site.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened fauna species:

Table 4.5 – State listed threatened fauna species with suitable habitat present

Common Name	*TSC Act*	Potential to occur
Yellow-bellied Sheathtail-bat	V	recorded
Eastern Bentwing-bat	V	recorded
Large-footed Myotis	V	recorded
Greater Broad-nosed Bat	V	recorded
East-coast Freetail Bat	V	recorded (Gunninah)
Little Eagle	V	✓
Little Lorikeet	V	✓
Swift Parrot	E	✓
Dusky Woodswallow	V	✓
Grey-headed Flying-fox	V	✓
Little Bentwing-bat	V	✓
Varied Sittella	V	✓
Eastern Falsistrelle	V	low
Cumberland Plain Land Snail	E	low
Spotted Harrier	V	unlikely
Square-tailed Kite	V	unlikely
Turquoise Parrot	V	unlikely
Powerful Owl	V	unlikely
Speckled Warbler	V	unlikely
Regent Honeyeater	E4A	unlikely

Note: Full habitat descriptions and an assessment of likely occurrence for these species are provided in Appendix 2

Four (4) state listed threatened fauna species including Greater Broad-nosed Bat (*Scoteanax rueppellii*), Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), were recorded within the study area.

The Yellow-bellied Sheathtail-bat was recorded only to a 'probable' level of certainty however this species as well as the Eastern Bentwing-bat and the East-coast Freetail Bat (*Micronomus norfolkensis*) were recorded during previous site surveys by *Gunninah* (2015). This is a total of five (5) state listed threatened fauna species recorded.

These species have been assessed in detail within Appendix 3. The impact assessment for these species has concluded a not significant impact provided that trees containing hollows are inspected for use by any threatened microbat species and the presence of such hollows are retained in-situ with appropriate buffers wherever possible, or compensatory habitat such as appropriately sized nest boxes are installed within nearby retained vegetation.

FM Act – No habitats suitable for threatened aquatic species were observed within the subject site and as such the provisions of this act do not require any further consideration.

(b) Endangered fauna populations (NSW)

There are no endangered fauna populations previously recorded within 10km of the study area or expected to occur.

(c) SEPP 44 Koala Habitat Protection

SEPP 44 Koala Habitat Protection applies to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. In addition, Part 2 of the Policy outlines a three (3) step process to assess the likelihood of the land in question being potential or core koala habitat. Part 2 applies to land which has an area of greater than 1 hectare or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.

The subject site is required to be considered under SEPP 44 as it falls within the Campbelltown LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the subject site is greater than 1 hectare, hence Part 2 – Development Control of Koala Habitats, of the Policy applies.

Potential Koala Habitat (PKH) is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the policy.

Core Koala Habitat (CKH) is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population.

A Koala Plan of Management is required to be prepared where council is satisfied that the land is CKH.

Step 1 – Is the land PKH?

One Koala food tree species Forest Red Gum (*Eucalyptus tereticornis),* as listed on Schedule 2 of SEPP 44 – was recorded within the subject site. These trees comprised

greater than 15% of the total number of trees within the Cumberland Plain Woodland vegetation community present and therefore is classified under SEPP 44 as 'potential Koala habitat'.

Step 2 – Is the land CKH?

No Koalas were directly observed at the time of fauna survey, which included diurnal searches of trees and spotlighting. In addition, there was no secondary evidence of Koala habitation in the area including characteristic scratches on trees and scats beneath trees.

A search of the Atlas of NSW Wildlife (OEH 2018) found five-hundred and fifty (550) records of Koala habitation within a 10 km radius of the study area. None of these records are within 3km of the study area and all are associated with the well-known Georges River population. As such the study area is not considered to comprise 'core Koala habitat' as defined under SEPP 44.

Step 3 – Koala Plan of Management

As the land is not considered to comprise CKH a Koala Plan of Management is not considered to be required.

4.3.5 National environmental significance - fauna

(a) Threatened fauna species (National)

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10km radius of the subject site. These species have been listed in Table A2.2 (Appendix 2), and those with potential habitat within the subject site are considered in the seven-part test within Appendix 3.

Based on the habitat assessment within Appendix 2, it is considered that the subject site 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
Swift Parrot	E	✓
Grey-headed Flying-fox	V	✓
Regent Honeyeater	CE	unlikely

No nationally listed threatened fauna species, were recorded within the study area during survey.

The Significant Impact Criteria for species listed under the EPBC Act 1999 is provided in Appendix 4. An assessment of impacts with consideration to this criteria has concluded that there will not be any likely significant impact on any nationally listed threatened fauna species with potential to occur, as a result of the proposed vegetation removal.

(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 10km radius of the subject site. The habitat potential of migratory fauna species is considered in Table A2.3 (Appendix 2).

No nationally protected migratory bird species were recorded present during the surveys. The impact assessment for nationally protected migratory species with potential to occur has concluded a not significant impact.

4.4 Vegetation connectivity and wildlife corridors

The managed woodland vegetation within the study area contributes to local connectivity towards the immediate south and east. The combined local connective landscape is however isolated from other major remnant or contiguous vegetation including any major conservation parks or reserves.

Whilst the study area does provide some degree of canopy only connectivity to this local remnant, removal of vegetation within the study area, will not cause any segmentation, fragmentation or isolation of this local connectivity. This is demonstrated in Figure 4 below.

The connectivity that will be maintained to the immediate south is represented by better quality unmanaged native vegetation able to support small terrestrial animal species and their habitats.

Threatened fauna species recorded during fauna survey or otherwise within the local connective landscape include the Cumberland Plain Land Snail, Greater Broad-nosed Bat, Large-footed Myotis, Eastern Bentwing-bat, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Grey-headed Flying-fox, Varied Sittella, Little Lorikeet and Little Eagle. Each of these are highly mobile flying species with the exception of the Cumberland Plain Land Snail, which was not found within the study area and is unlikely to occur. The removal of habitat for the proposed vegetation removal will not likely inhibit or reduce local movements for any of these remaining flying species.

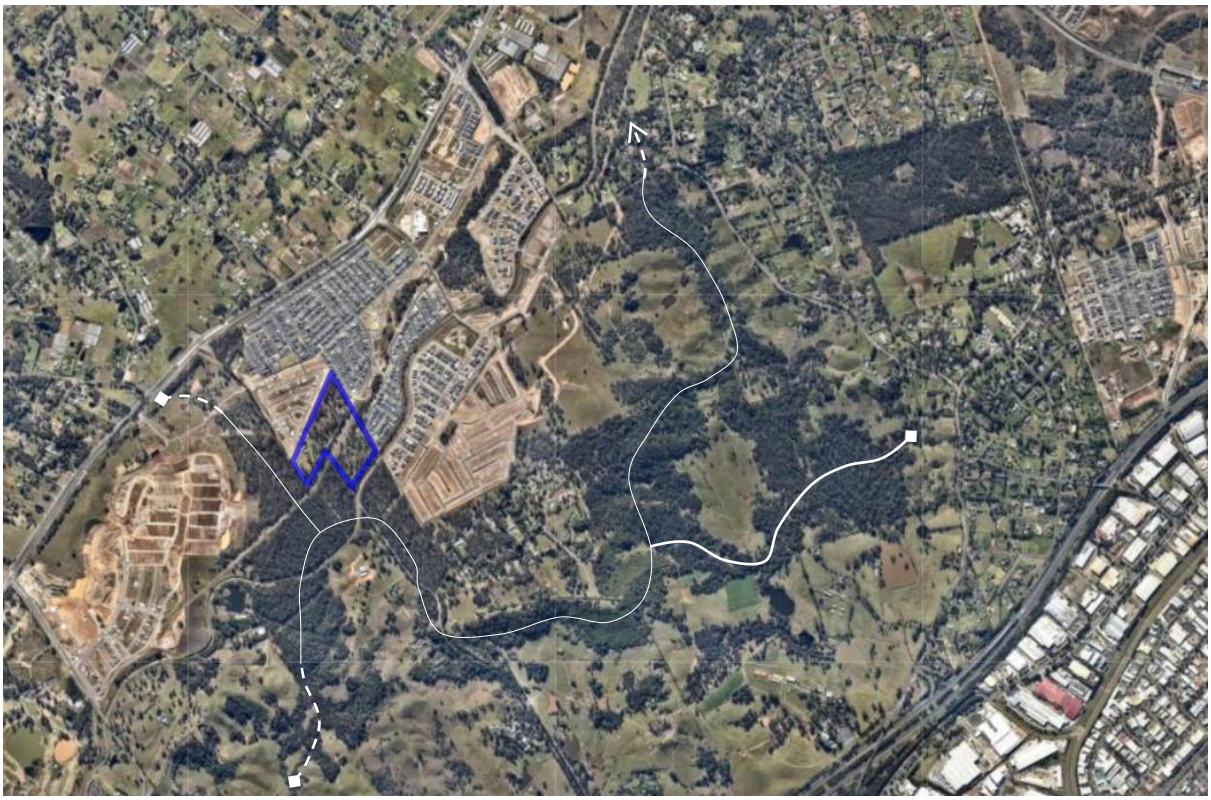


Figure 4 – Local connectivity

Conclusion 5

Travers bushfire & ecology has been engaged to undertake a flora and fauna assessment for a proposed rezoning within Lot 71 DP 706546, 71 St Andrews Road, Varroville.

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

It is concluded that the proposed vegetation removal within Lot 71 DP 706546, 71 St Andrews Road, Varroville, is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats.

The proposed zonings are also suitable for the site in terms of its current condition and the ability of the zoning to result in a positive ecological outcome for the site. Offsetting under the Biodiversity Offsets Scheme also results in a better conservation outcome on lands that can be conserved with a higher level of resilience.

5.1 Legislative compliance

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995*, four (4) threatened fauna species including Greater Broad-nosed Bat (*Scoteanax rueppellii*), Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), no threatened flora species and one (1) EEC, Cumberland Plain Woodland, were recorded within the study area.

The Yellow-bellied Sheathtail-bat was recorded only to a 'probable' level of certainty however this species as well as the Eastern Bentwing-bat and the East-coast Freetail Bat (*Micronomus norfolkensis*) were recorded during previous site surveys by *Gunninah* (2015).

In accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*, the 7 part test of significance concluded that the proposed vegetation removal will not have a significant impact on any threatened species, populations or EECs provided that further survey to identify potential bat roosting is undertaken and recorded threatened bat roosts are retained in-situ. In this case, a Species Impact Statement should not be required for the proposal.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, no threatened fauna species, no protected migratory bird species, no threatened flora species, and no EEC under this Act were recorded within the study area. The proposed vegetation removal was not considered to have a significant impact on matters of national environmental significance as the vegetation present and being impacted is not considered to meet the condition criteria to be commensurate with

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. Offsetting of the biodiversity impacts is recommended to ensure a 'maintain or improve' outcome is achieved. As such a referral to Department of Environment and Energy is not required.

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

5.2 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:-

The direct impacts of the proposal within the subject site area is considered as:

- Removal/modification of 4.61 ha of highly degraded Cumberland Plain Woodland within the land to the north-west of the powerline easement consisting of low condition canopy vegetation (3.41 ha of moderate canopy & 1.2 ha of sparse canopy)
- Subsequent removal of threatened fauna species foraging habitat
- Reduction in local connectivity and patch size of remnant bushland areas
- Removal of small and medium sized hollows suitable for recorded threatened species

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into the adjacent remaining natural habitat areas
- Reduced cross-site movements by small bird species such as passerines.
- Increased presence of pet cats and dogs in the locality and subsequent resultant impacts on native wildlife.
- Increased spill-over from noise, activity, scent and lighting effects into the adjacent natural habitat areas.

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

- Cumulative loss of Cumberland Plain Woodland
- Cumulative loss of winter flowering resources and threatened species habitat
- Further reduction of the connective remnant
- Increased varied human presence and activity within the remaining natural habitat areas of the adjacent bushland remnant.
- Edge effects from inappropriate use of remaining native vegetation areas such as additional clearing, dumping of materials, dumping of food or general waste and building refuse.

5.3 Mitigation and amelioration of impacts

The following recommendations are made to avoid, minimise or ameliorate the above potential ecological impacts, address threatening processes and to create a positive ecological outcome for threatened species and their associated habitats.

- Residual impacts of the proposed vegetation removal are to be offset through the Biodiversity offsetting scheme.

- The retained E3 land is protected under an 88B instrument or a conservation agreement.

- A voluntary planning agreement be established to conserve the E3 lands and require restoration of CPW vegetation in accordance with an approved vegetation management plan.

- A vegetation management plan is to be submitted and approved by Council and works completed prior to release of the subdivision certificate.

- All trees removed within the proposed R2 zone are used to restore on-ground log and snail habitat within the retained E3 lands.

- 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 natural vegetation retention shall be protected by fencing, prior to construction, to ensure that these areas are not damaged during the vegetation removal.

- Construction activities will be intermittently supervised on-site, monitored and audited by a project ecologist to ensure that the recommendations of this report are implemented.

- Target weed control is to be undertaken across all retained E3 lands to improve the condition of the ground layer and assist in natural regeneration as well as reduce competition against planted native understorey species.

- 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 or tracks of vehicles or machinery. 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.

- Erosion control measures are to be in place to reduce temporary erosion and sedimentation risks to adjacent vegetation and any nearby drainage channel.

- All areas containing natural habitat features which have been identified for retention are to be protected with fencing prior to construction

- Hollows present within the proposed vegetation clearing area are to be inspected for the presence of roosting by recorded threatened microbat species. If any of these hollows are found to contain such a roost (which is not expected) then this tree is to be retained with appropriate buffers from the development landscape or alternatively hollows are to be re-located or replaced with nest boxes of a similar size within adjoining retained vegetation. The same inspections and protections are required for any hollow-bearing trees located within E3 area to the south-east of the powerline easement.

- According to DEC (2004) survey Guidelines, stag-watching of all trees should be undertaken during warmer months (October - March). Outside of this period microbats may become dormant during cooler months therefore tree climbing

inspections with use of a videoscope should be undertaken at this time to effectively determine presence and use of hollows.

- Where the felling of hollow-bearing trees is required, this is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for threatened species not previously recorded within these hollows. Hollows of high quality or with fauna recorded residing within should be sectionally 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 the E3 conservation area to the south-east of the powerline easement. Nest boxes may be constructed to replace a removed hollow however a relocated/refurbished natural hollow is preferred for use by threatened microbat species. Constructed boxes should be constructed entirely 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 a hollow then the 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 hollow section 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 fauna species, a nest or roost is located during development works, then works should cease until safe relocation can be advised by a contact fauna ecologist.

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Fauna Survey Methodologies

A1

The fauna survey methods outlined within this Appendix are techniques employed by *Travers bushfire & ecology,* based on industry standards as well as additional methods found to be effective for select fauna groups. The fauna survey techniques deployed for each specific site are outlined within the survey effort table in the main body of this report. The techniques selected will depend upon the site characteristics and extent of available habitat as well as restrictions such as available survey time and weather conditions.

If any additional or target survey techniques for fauna species are undertaken, beyond the methods outlined within this Appendix, the details of these will be described within the main body of this report.

1 Standard survey techniques

1.1 Diurnal birds

Diurnal birds are typically identified visually and / or by calls during diurnal surveys. Habitat searches to identify nests, feathers, eggs, or signs of foraging may be utilised more specifically for identifying threatened diurnal bird species.

Visual observations are made more accurate with the use of binoculars and where necessary or practical, with the use of a spotting scope. Binoculars are carried by the fauna surveyor at all times during nocturnal and diurnal fauna surveys. A birding field guide is always available in the field when required for verifications.

Calls are identified in the field by the fauna surveyor. If an unknown call is heard it is cross-matched to comprehensive bird call reference libraries taken into the field. A call library of birds occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Diurnal bird census points may be undertaken at large sites where the total area may not be effectively covered during the survey period, or as a measure to ensure focused bird only survey.

Song-meters may also be used for remote diurnal bird call surveys in pre-selected diurnal periods (particularly during the dawn chorus) over the deployment period.

1.2 Nocturnal birds

Searches for evidence of Owl roosts, key perches and potential Owl roosting / breeding hollows are made during diurnal site searches. Whitewash, feathers or regurgitated pellets give key information. Pellets are sent for analysis of contents to assist in identification where necessary.

Generally, the presence of nocturnal birds during the nocturnal period is first determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this,

and provided no calls are heard, call-playback techniques are employed for threatened species that have suitable habitat present.

Threatened nocturnal birds known to provide response to call-playback techniques include Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebricosa*), Grass Owl (*Tyto longimembris*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for five minute periods with five minute intervals of quiet listening for a response. This is followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

Separation distances between broadcasting stations during a single night of survey are advised for different species within survey guidelines. These include 1km between Owl calls and 3km between Bush Stone-curlew calls. Subsequent to this, separate broadcasting stations will be deployed on the same night where sites of significant size are surveyed. Separations for bitterns are not advised and these may be broadcast at a number of stations along suitable habitat areas.

Where an owl species has been recorded or is known to occur, call-playback techniques will not be deployed for that species to prevent disturbance of breeding activity. Where a threatened owl is known to occur appropriate additional effort will be undertaken to identify appropriate nesting/roosting trees and identify signs of use as per the methods guided by owl specialist John Young. These techniques vary pending the time of year but all with a focus to identify key breeding and roosting habitat trees and areas.

Stag-watching at appropriate times of year will also be undertaken where suitable large hollows for Owl nesting / roosting show signs of activity or are located within development areas. Full covert or semi-covert Reconyx surveillance cameras may be mounted at suspected hollows to target owl use and behaviour.

Song-meters may also be used to remotely target presence of owls by recording calls in selected nocturnal periods (particularly after dusk and before dawn) in the early breeding period.

1.3 Arboreal mammals

Arboreal mammals may be surveyed using Elliott type A, B and / or C traps, small and / or large hair tubes, surveillance cameras, video endoscope, spotlighting, call-playback techniques, scat searches or searches for other signs of activity.

Baiting and layout for Elliott trapping and hair tubing are typically incorporated into terrestrial trapping and hair tubing effort, unless where target survey is undertaken. Standard baiting and layout is therefore described in Section A1.4 below within terrestrial survey methods. Where gliders are targeted, the standard bait mix may be additionally laced with a nectarivor powder mix used for feeding captive birds. Where Brush-tailed Phascogales are targeted the standard bait mix may be additionally laced with an insectivore powder mix. Where Eastern Pygmy Possum is targeted, the bait mix will be more heavily laced with honey.

Elliott traps for arboreal captures are placed onto tree mounted platforms that are attached to the trunk 2-3m above the ground, at an incline to facilitate drainage during inclement weather. Plastic sleeves are placed around or over traps when there is a possibility of wet weather in the forecast. Arboreal hair tubes are attached to the trunk of trees using rubber bands with the tube entry facing down, preventing water entry.

For all arboreal traps and hair tubes a mixture of honey and water is sprayed onto the trunk up to 8m above the trap and around the trap as a lure. Where Eastern Pygmy Possum is targeted, a high concentrate honey water mix is also sprayed from the base of trunk up and along connective branches.

Arboreal traps and hair tubes are placed in trees selected to bias target species. These are often flowering or sap flow trees for gliders, rough-barked trees for the Brush-tailed Phascogale and Banksias for the Eastern Pygmy possum.

Surveillance cameras may be used to target arboreal mammals in instances where the camera can be placed targeting a location on a tree where baiting is placed. This method may utilise the efforts of tree climbers to permit placement a good height, particularly in instances where scratches indicate regular usage patterns or a hollow is a suspected den.

A videoscope is used for active observations of hollow cavities for the presence of arboreal mammals (and other hollow-dependent fauna). Where a cavity extends beyond the cable distance an angle drill hole is made from the outside so sections can be viewed down to the base. Single photo or video footage may be recorded to assist identification or where only nest bedding material is recorded. This may also be used for later verification of identification.

Where habitat is suitable, the presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for five minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting. Arboreal gliders are also identified from characteristic sap feeding scars on select tree species.

1.3.1 Koala survey

Koala survey is undertaken where the site is considered to provide potential habitat under the definitions of SEPP 44 - Koala Habitat Protection, or in the presence of feed trees listed in Appendix 1 of the Recovery Plan for the Koala. Habitat may also be defined according to locally prepared Koala Plans of Management.

SEPP 44 is applied to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. Part 2 is applied to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

To determine Potential Koala Habitat (PKH) under the definitions of SEPP 44 an estimate of the percentage density of each tree species within vegetation communities is determined by averaging the percentage of stems counted. PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the Policy.

Where Koala habitat is considered to be present, the site will be surveyed on foot, with known Koala food trees being inspected for signs of use. Trees are inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. Koalas may also be targeted during nocturnal survey involving call-playback techniques and spotlighting.

For large sites, Koala search quadrats may be employed within portions of communities where feed trees are present at suitable densities. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw ‘pock’ marks on the trunk and faecal pellets around the base. Pellet searches are undertaken according to the tree base

search methods described in *Phillips & Callaghan* (2008). Search quadrats are less labour intensive than the SAT techniques described below but may only be an initial survey effort to determine presence / absence.

Where any Koala activity is recorded the complete Spot Assessment Technique (SAT) described by *Phillips & Callaghan* (2008) may be undertaken as a measure of Koala *activity*. This technique may also be employed in the first instance as an indicator of presence / absence, particularly where a site has potential Koala activity based on previous records.

For any survey technique, the location and density of Koala droppings, if found, are documented.

1.4 Terrestrial mammals

Various traps may be used to survey for the presence of terrestrial mammals. These include Elliott trapping, medium and large cage trapping, small and large hair tubing and pitfall traps. Other survey methods for terrestrial mammals include the use of surveillance cameras, song-meters, spotlighting and activity searches.

Arboreal and terrestrial Elliott traps and hair tubes are placed in grids, or more commonly along trap-lines of 5-10 traps separated by distances of 20-50m, depending on site size and variation of habitat. Trap or hair tube sizes selected at each trap station may alternate or may have an emphasis on certain sizes according to target species.

Selection of terrestrial Elliott trap, cage trap, hair tube or pitfall trap locations has an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all Elliott traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat, chicken or roadkill to target Spotted-tailed Quoll. Where Potoroos or Bandicoots are targeted, truffle oil may be used to lace the standard bait mix or used on its own.

Surveillance cameras are used in terrestrial mammal surveys particularly for detection of a broad target group or shy species. The surveillance camera is mounted on a tree and directed towards a closed baited trap or canister. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, runways, etc.

Song-meters may be used as a supplementary surveying tool to identify mammal calls including Yellow-bellied Glider, Squirrel Glider and Spotted-tailed Quoll.

During diurnal site searches, assessment is made of ‘found’ scats, markings, diggings, runways and scratches located. Any scats or pellets not readily identifiable (particularly predator scats) may be collected and sent to Barbara Triggs for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using ultrasonic recording detectors or trapped using harp (Constantine) traps, mist nets or trip lines. Microchiropteran bats are also surveyed by searches of subterranean habitats such as caves, tunnels or shafts where present, or by searching structures such as under bridges and abandoned buildings or wall / ceiling cavities, where entry is possible.

Ultrasonic recording detectors are used in fixed passive monitoring positions. Active monitoring may also be used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification. Active monitoring utilises a handheld sonograph recording microbat calls in real-time. Spotlighting of the microbat is then used to determine size and wing morphology to assist in finer differentiation between species with similar call shape and frequencies.

Harp traps and mist nets are placed along suitable 'flyways' such as along open narrow road / river corridors to maximise the likelihood of captures. Traps may be purpose set to capture bats emerging from roosts by being placed at the entry of tunnels / caves or draped over the edge of bridges. Trip lines are placed over water to trip low flying drinking bats into the water. These bats are collected as they swim to the waters edge.

Harp traps are checked during early nocturnal survey, as well as each morning. Mist nets and trip lines require constant monitoring. Captured bats are identified using field identification guides. Bats are released at the point of capture after dusk or placed under trunk bark / splits of nearby trees.

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.

1.6 Amphibians

Amphibians are surveyed by vocal call identification, call-playback, spotlighting along the edge of water-bodies, pitfall trapping, funnel trapping, by driving along sealed roads near waterways, habitat searches and collection of tadpoles.

Calls are identified in the field by the fauna surveyor. For similar calling species, or if an unknown male call is heard, it is cross-matched to frog call reference libraries taken into the field. A call library of frogs occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Threatened frog species that call in chorus may be targeted by use of call-playback techniques where suitable habitat exists, with some species more reliable than others in providing a response. Red-crowned Toadlet may also be targeted by clapping and loud retort along suitable habitat drainages in order to evoke a call response.

Any amphibians found are visually identified and, when required to be examined, are handled with latex gloves and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snap-lock clear plastic bag for analysis of colour and morphological features. Where tadpole identification cannot be made in the field tadpoles are placed in a small glass box with laminated grid paper and dorsal and lateral photos are taken. These are supplied to Marion Anstis or Dr Arthur White for identification.

Song-meters may also be used to remotely record frog calls in selected periods (particularly during dusk) close to breeding areas over a preselected recording period.

Amphibian survey yields best results during or following wet periods with seasonal breeding and subsequent male calling varying according each species. Targeted survey is thus undertaken in appropriate seasons.

1.7 Reptiles

Reptiles are surveyed opportunistically during diurnal site visit(s), but also by habitat searches, pitfall trapping, funnel trapping, by driving along roads on humid nights and by camera surveillance at burrows.

Habitat searches for reptiles are undertaken in likely localities such as under logs, rocky slabs on rock surfaces, under sheet debris, under bark exfoliations and leaf litter at the base of trees and along the edge of wetlands. Aspect and land surface thermal properties are considered to determine best search locations particularly along rocky escarpments.

During warmer months spotlighting may assist survey effort particularly during humid conditions.

1.8 Invertebrates

Target survey is undertaken for Cumberland Plain Land Snail (*Meridolum corneovirens*) or Dural Land Snail (*Pommerhelix duralensis*) when in proximity to previous *Bionet* records and particularly where typical host vegetation communities are present. The most appropriate areas of observed habitat are searched. Dense areas of leaf litter with likely moisture retaining properties are scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks are also turned over. In large survey areas, search quadrats are undertaken evenly across highest quality habitat areas to estimate population size.

The top (spiral side), side (showing aperture) and underside (showing umbilicus) of snail specimens found are photographed and sent to Michael Shea or Frank Koehler of the Australian Museum Malacology Unit for confirmation of identification.

2 Habitat trees

Hollow-bearing tree surveys use a *Trimble* handheld GPS unit to log both field reference location as well as tree data. Data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height are documented. A metal tag with the tree number is placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging are also noted.

3 Survey effort table descriptors:

Target - Where effort is specifically concentrated towards an individual species. Selected target species will be identified within the survey effort table and where necessary described within the report.

Opportunistic - Where birds are identified by observation, call or indirect methods as the opportunity arises.

Habitat search - Where suitable areas of habitat for selected fauna groups such as frogs, reptiles and invertebrates are specifically searched.

Diurnal bird census point(s) - Bird surveys are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. Size and time will be specified in the survey effort table. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently census points are selected to adequately represent each of the habitat areas present and particularly areas designated for proposed development. Often census points are commenced at locations where bird activity is noticeably high.

Spotting-scope outlook - A *Nikon* spotting scope with 16~47 zoom at x60 magnification on a mounted tripod is used for distant inspections of diurnal birds. This is undertaken at wetlands for viewing waterfowl and waders but also other difficult to access areas. It may also be used for inspecting activity at nests, hollows and combined with spotlight for a panoramic search in open areas.

Call-playback - This involves broadcasting pre-recorded calls from CD through a 15 watt Toa 'Faunatech' amplifier to evoke a response from a target species known to reply. Species selected for call-playback will be indicated in the survey effort table.

Spotlighting - Is carried out using a hand held Olight LED spotlights with varied light intensity settings. This technique involves walking amongst the woodland areas, forest fringes, along roads, trails and fence lines so that a maximum number of trees can be observed. Intensity is regulated depending on the vegetation structure and distances viewed to enable eye-shine without retina damage to observed animals. Spotlighting around water-bodies and particularly along the shallow fringes is used for finding frogs. Spotlighting is used in combination with binoculars or spotting scope for closer night inspections.

Stag-watching - Involves watching hollows in the dusk period approximately 15 minutes prior to dark until 30 minutes following dark. Placement of the observer on the ground allows for a silhouette of any emerging fauna to be seen against the lighter sky background such that a spotlight is not required, which would likely to disrupt emergence behaviour. Where any movement is observed, a spotlight may then be used for identification purposes.

Search quadrats - Are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently quadrats are selected to adequately represent each of the suitable habitat areas present and particularly areas designated for proposed development. The use of this technique simply as an initial time-effective suitable indicator of presence / absence of Koalas has been discussed with Koala expert, Stephen Phillips.

Koala Spot Assessment Technique (SAT) - Method outlined by *Phillips & Callaghan* (2008) and accepted by the Australian Koala Foundation to determine Koala activity levels. Activity levels are calculated from the proportion of trees showing signs of Koala use as indicated by the presence of scats as well as site location within the state.

Elliott trapping - Using *Elliott* type A (33x10x10cm) and Type B (45x15x15cm), B and / or Type C traps for trapping small sized mammals. Trapping nights' effort will be indicated in the survey effort table. Trapping layout, trap sizes, baiting and trapping period will be outlined within the site specific methodology section.

Medium cage trapping - Using medium sized cage traps (17x17x45cm foldout cages with tread-plate mechanism or 22x25x58cm rigid cage with tread-plate mechanism) for trapping up to cat/bandicoot sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Large cage trapping - Using large sized cage traps (25x25x50cm foldout cages with pull lever (meat) mechanism, 28x28x60cm foldout cages with tread-plate mechanism or 30x30x70cm rigid cage with tread-plate mechanism) for trapping up to quoll sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Hair tubing - Using small (40mm diameter x 120mm long) and/or large (90mm diameter x 200mm long) PVC pipe sections for collecting mammal hair samples. At one end of each tube is an enclosed chamber where the bait is placed and capped. Small drill holes in the inside face of the chamber allow the smell of the bait to permeate out through the tube without allowing access to the bait. At the other open entry end, double-sided tape is attached around the inner rim so hair samples of animals entering the tube are collected.

Hair samples collected are sent to Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

EPP denning tubes - Using (80mm diameter x 240mm long) PVC pipe sections to provide a nesting/denning opportunity for Eastern Pygmy Possum. Both ends and covered and sealed with PVC caps. A 60mm diameter cardboard post-pack tube wrapped in bubble wrap for insulation and capped at the base is placed inside the PVC pipe. A 33mm drill hole on the side at one end permits access and velcro tape stuck down the internal cylinder allows the animal to climb down to the base. Cut lines around the outer surface of the tube permit small mammals to climb up the outside. Denning tubes are placed vertically in shrub trees (preferably flowering banksias). If no animals are found residing within the tube after a prolonged survey period (generally 6 weeks) use may then instead also be identified from bedding material present. Pygmy Possums use fine bedding material such as *Isopogon* and *Banksia ericifolia* by comparison to Feather-tail Gliders and Antechinus which use eucalypt leaves.

Pitfall trapping - Is used to survey for small terrestrial mammals, frogs, reptiles and invertebrates. Pitfall trapping involves the use of 15cm diameter and 60cm long PVC stormwater pipe sections placed vertically into pre dug holes. The pipe is placed and set firm with surrounding soil so that the top rim is level with the ground surface. Drift fences made of damp-proof-course 270mm wide are held tight and upright by wooden and steel pegs and run along the length of each trap-line. Drift fences are run over the middle of each pit in the trap line ensuring at least 5m of fencing is run along each side of each pit. Ground fauna passing beyond the pitfall transect are diverted towards the pits along the fence line.

Funnel trapping - Is used to survey mainly for frogs and reptiles. Funnel traps are 18cm x 18cm x 75cm long and constructed of shade cloth with an internal spring and wire frame in a similar design to yabby traps. At each end an inward facing funnel directs fauna through a 4cm hole and into the trap. Herpetofauna search the walls and corners for an exit and discover it difficult to re-find the internal exit hole. As with pitfall traps, funnel traps are used with drift fences that divert fauna towards the trap entry. At least 5m of fencing is run between each funnel trap which may be placed on either side of the fence. Trapping layout, target species, fence lengths and trapping period will be outlined within the site specific methodology section.

Passive microbat monitoring - Involves leaving the Anabat (Mk2 or SD-2) or SM4Bat zero-crossing recorders in a fixed mounted position to record call-sequences of passing bats. Recording locations are determined in order to represent different available foraging structures for various micro-chiropteran bat species. Dams, cleared flyways, high insect activity areas, forest edges and ecotones are particularly targeted. Bat call recordings are analysed using Analook 3.7.23 computer software.

Active microbat monitoring - Is a method of active microbat recording during stag-watching or during nocturnal spotlighting survey. Active monitoring involves walking with an Echo Meter Touch microphone allied to a mobile acoustics spectrogram app on iPhone for viewing call-sequences in real-time. When calls are heard the transducer microphone is actively directed towards the calling animal with the aid of a spotlight, so longer and clearer call sequences may be recorded. When calls of a potential threatened species are observed on the sonograph a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle microbat monitoring - Is a method of active microbat recording deployed when large distances need to be covered in a nocturnal survey period. A Hi-mic extension cable allows the transducer microphone to be placed on a bracket on the roof of a travelling vehicle so calls may be viewed whilst driving. The vehicle travels at no more than 40km/h to prevent wind interference. When calls of a potential threatened species are observed on the dash mounted PDA screen active spotlighting is undertaken.

Harp trapping - Is used to capture microchiropteran bats. Harp traps have an aluminium frame with a two-bank 4.2m^2 area and calico capture bag set along the base area.

Mist netting - Is used to capture microchiropteran bats. The mist net capture area is 2.4m high and 9m wide and supported by two 3.5m poles which are braced with ropes and pegs. Design is a 0.08mm ultrafine nylon monofilament thread arranged in a 14x14mm mesh, with four horizontal capture pockets. These features are specific for the use to capture micro-chiropteran bat species and are provided from the only known supplier in Poland.

Trip lining - Is used to capture microchiropteran bats. Fishing line is strung tight on pegs in a zig-zag pattern across open water-bodies just above the water surface to trip drinking bats into the water.

Surveillance camera - Is used to remotely monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A Reconyx Hyperfire HC500, HC550 or HC600 digital weatherproof camera with a passive motion detector and a night-time infrared illuminator is used depending on the target outcome. Full covert or semi-covert cameras will be used to maximise recordings or for behaviour, whilst white-flash cameras will be used for colour identification. The camera is mounted on a tree or tripod and takes three consecutive photo frames on the detection of movement up to 30m away or the detection of a heat/cold source different to the ambient temperature.

Song-meters - are used to remotely record animal calls. SM4 bioacoustics song-meters may be programmed to record during select periods in the day depending on the targeted activity. Song Scope software may be used to create a recogniser file and determine the frequency of calls over the recorded period, which may be effective in determining local breeding activity, numbers and locations.

Videoscope - is used for active observations of hollow cavities for the presence of arboreal mammals and other hollow-dependent fauna. A Dellon industrial endoscope with a 1m cable and rotational camera head and LED light allow real-time inspection down irregular shaped cavities to be viewd on the attached LCD screen. Single photo or video footage may be recorded.

Weather conditions - Survey effort for each fauna group accounting for methods undertaken, duration, and weather conditions are provided in the survey effort table. Weather details are documented for all survey techniques and include:

- air temperature
- cloud cover
- rain (e.g. none, light drizzle, heavy drizzle, heavy rain)
- recent rain events (where relevant)
- wind strength e.g. calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns)
- wind direction
- moon (where relevant) (e.g. none, 1/4 moon, 1/2 moon, 3/4 moon, full moon)

Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 provides an assessment of potential habitat within the subject site for state and nationally listed threatened flora species recorded within 10km on the Atlas of NSW Wildlife (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act* Protected Matters Tool.

Table A2.1 – Threatened flora habitat assessment

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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 OEH 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	closest record 5km	61 recent records nearby	unlikely and not expected	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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**	
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
Asterolasia elegans EPBC	E1	E	Erect shrub 1-3m high growing in moist sclerophyll forests on Hawkesbury sandstone slopes hillsides. Distribution limits Maroota region.	x	x	-	-	x	x
Cryptostylis hunteriana EPBC	V	V	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S-south of Eden.	x	x	-	-	x	x
Cynanchum elegans OEH EPBC	E1	E	Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. Distribution limits N-Gloucester S-Wollongong.	x	x	Closest record <1km	No recent records	prefers more shale woodland	x
Dillwynia tenuifolia OEH	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	Closest record 9km	One recent record	unlikely and not expected to occur	x
Eucalyptus benthamii OEH EPBC	V	V	Blue gum to 40m high. Wet forest on sandy alluvial soils. Distribution limits N-Yarramundi S-Bents Basin.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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**	
Eucalyptus scoparia OEH	E1	V	Smooth-barked tree only known from vicinity of Bald Rock.	x	x	-	-	x	x
Genoplesium baueri OEH 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* OEH	V	-	Erect to spreading shrub 0.5-1.5m tall. Grows on laterite and Tertiary alluvium. Distribution limits St Marys-Londonderry-Prospect.	x	x	-	-	x	x
Grevillea parviflora subsp. *parviflora* OEH EPBC	V	V	Open to erect shrub to 1m. Grows in woodland on light clayey soils Distribution limits N-Cessnock S-Appin.	x	x	Closest record 10km	1 recent record	unlikely and not expected to occur	x
Gyrostemon thesioides OEH	E1	-	Multi-stemmed shrub to 70cm. Grows on hillsides and riverbanks. Confined to Georges and Nepean Rivers and believed extinct.	x	x	-	-	x	x
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
Hibbertia puberula OEH EPBC	E1	-	Found in the central coast botanical subdivision in sandy soil often associated with sandstone. Has not been collected for over 40 years	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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**	
Leucopogon exolasius OEH EPBC	V	V	Erect shrub to 2m high. Rocky hillsides and creek banks in Sydney Sandstone Gully Forest. Confined to Woronora and Georges Rivers and Stokes Creek.	x	x	-	-	x	x
Leucopogon fletcheri subsp. *fletcheri* OEH	E1	-	Shrub to 1.8m high growing in woodland on lateritic soils. Distribution limits N-St Albans S-Springwood.	x	x	-	-	x	x
Maundia triglochinoides OEH	V	-	A reed-like herb which grows in swamps and shallow fresh water on clay. Distribution Limits N-Qld border S-Wyong.	x	x	-	-	x	x
Melaleuca deanei OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. Distribution limits N-Gosford S-Nowra.	x	x	-	-	x	x
Pelargonium sp. Striatellum EPBC	E1	E	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 hirsuta OEH 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

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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 nutans OEH EPBC	E1	E	Erect to spreading shrub. Grows in dry sclerophyll forest and woodland on laterite and alluvial sands. Distribution limits Cumberland Plain.	x	x	-	-	x	x
Pimelea curviflora var. *curviflora* OEH 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 OEH 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	✓ but limited	Closest record 2km	429 recent records	Potential	✓
Pomaderris brunnea OEH EPBC	V	V	Shrub to 3m high. Confined to Upper Nepean and Colo Rivers where it grows in open forest.	x	x	-	-	x	x
Pterostylis gibbosa EPBC	E1	E	Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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**	
Pterostylis nigricans OEH	V	-	Terrestrial orchid. Prefers coastal heathland with Heath Banksia (Banksia ericifolia), and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils. The Dark Greenhood occurs in north-east NSW north from Evans Head, and in Queensland.	x	x	-	-	x	x
Pterostylis saxicola OEH 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
Pultenaea parviflora OEH EPBC	E1	V	Erect shrub. Grows in dry sclerophyll forest at the intergrade between Tertiary Alluviums and Wianamatta Shales. Distribution limits Cumberland Plain.	x	marginal	Closest record 10km	No recent records	unlikely and not expected to occur	x
Pultenaea pedunculata OEH	E1	-	Prostrate shrub. Grows in dry sclerophyll forest and disturbed sites. Confined to Prestons and Villawood in NSW.	x	marginal	Closest record 6km	3 recent records	unlikely and not expected to occur	x
Syzygium paniculatum OEH EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N-Forster S-Jervis Bay.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					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**	
Thelymitra sp. 'Kangaloon' *(Thelymitra kangaloonica)* EPBC	E4a	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
Thesium australe OEH 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

OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife*
EPBC	- Denotes species listed within 10km of the subject site 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

Table A2.2 provides an assessment of potential habitat within the subject site for state and nationally listed threatened fauna species recorded within 10km on the *Atlas of NSW Wildlife* (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act* Protected Matters Tool.

Table A2.2 – Threatened fauna habitat assessment

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* OEH EPBC	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.*	×	×	-	-	×	×
Red-crowned Toadlet *Pseudophryne australis* OEH	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.*	×	×	-	-	×	×
Green and Golden Bell Frog *Litoria aurea* OEH EPBC	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.*	×	×	-	-	×	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* EPBC	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.*	×	×	-	-	×	×
Southern Bell Frog *Litoria raniformis* EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution Limit: N-ACT Bay. S-Albury.*	×	×	-	-	×	×
Broad-headed Snake *Hoplocephalus bungaroides* OEH EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. *Distribution Limit: N-Mudgee Park. S-Nowra.*	×	×	-	-	×	×
Freckled Duck *Stictonetta naevosa* OEH	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. *Distribution Limit: N- Tenterfield. S-Albury.*	×	×	-	-	×	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* EPBC	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.*	×	×	-	-	×	×
Spotted Harrier *Circus assimilis* OEH	V	-	Utilises grassy plains, crops and stubblefields; saltbush, spinifex associations; scrublands, mallee, heathlands; open grassy woodlands. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	✓	unlikely	✓
White-bellied Sea Eagle (*Haliaeetus leucogaster*) OEH	V	-	Occupies coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs. *Sedentary; dispersive. N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Little Eagle *Hieraaetus morphnoides* OEH	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.*	×	✓	✓	✓	✓	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* OEH	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.*	×	✓	×	✓	unlikely	✓
Black Falcon *Falco subniger* OEH	V	-	Inhabits plains, grasslands, foothills, timbered watercourses, wetland environs, crops; occasionally over towns and cities. *N-Tweed Heads. S-South of Eden.*	×	✓	×	×	Not likely	×
Bush Stone-curlew *Burhinus grallarius* OEH	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. *Distribution Limit: N-Border Ranges National Park. S-Near Nowra.*	×	marginal	×	×	Not likely	×
Red Knot *Calidris canutus* OEH	-	E	The red knot is a small to medium migratory shorebird. During the non-breeding season in Australasia, the red knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts and sometimes on sandy ocean beaches or shallow pools on exposed rock platforms. They are occasionally seen on terrestrial saline wetlands near the coast and on sewage ponds and saltworks.	×	×	-	-	×	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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 Painted Snipe *Rostratula australis* EPBC	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.*	×	×	-	-	×	×
Curlew Sandpiper *Callidris ferruginea* EPBC	E	CE	Mainly coastal, but many inland feeding along tidal mudflats, salt marsh, salt fields, fresh, brackish or saline wetlands and sewerage ponds. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Eastern Curlew *Numenius madagascariensis* EPBC	-	CE	Primarily coastal especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. Often recorded among saltmarsh and on mudflats fringed by mangroves and also in coastal saltworks and sewage farms. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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**	
Gang-gang Cockatoo *Callocephalon fimbriatum* OEH	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.*	×	×	-	-	×	×
Glossy Black-Cockatoo *Calyptorhynchus lathami* OEH	V	-	Open forests with *Allocasuarina* species and hollows for nesting. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Little Lorikeet *Glossopsitta pusilla* OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution Limit: N-Tweed Heads. S-South of Eden*.	×	✓	×	✓	✓	✓
Swift Parrot *Lathamus discolour* OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution Limit: N-Border Ranges National Park. S-South of Eden*.	×	✓	✓	✓	✓	✓
Turquoise Parrot *Neophema pulchella* OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. *Distribution Limit: N-Near Tenterfield. S-South of Eden.*	×	✓	×	×	unlikely	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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**	
Powerful Owl *Ninox strenua* OEH	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	×	✓	×	✓	unlikely	✓
Masked Owl *Tyto novaehollandiae* OEH	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.*	×	✓	×	×	Not likely	×
Eastern Bristlebird *Dasyornis brachypterus* EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Speckled Warbler *Chthonicola sagittata* OEH	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.*	×	Sub-optimal	×	✓	unlikely	✓
Regent Honeyeater *Xanthomyza Phrygia* OEH EPBC	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.*	×	✓	×	×	unlikely	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* EPBC	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.*	×	✓	×	×	Not likely	×
Black-chinned Honeyeater *Melithreptus gularis gularis* OEH	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.*	×	✓	×	×	Not likely	×
Varied Sittella *Daphoenositta chrysoptera* OEH	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*.	×	Sub-optimal	✓	✓	✓	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* OEH	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 southwestern Australia.*	×	✓	✓	✓	✓	✓
Hooded Robin *Melanodryas cucullata cucullata* OEH	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.*	×	×	-	-	×	×
Scarlet Robin *Petroica boodang* OEH	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.*	×	✓	×	×	Not likely	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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**	
Flame Robin *Petroica phoenicea* OEH	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.*	×	✓	×	×	Not likely	×
Spotted-tailed Quoll *Dasyurus maculatus* OEH EPBC	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.*	×	×	-	-	×	×
Koala *Phascolarctos cinereus* OEH EPBC	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.*	×	✓	×	×	Not likely	×
Eastern Pygmy Possum *Cercatetus nanus* OEH	V	-	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. *Distribution Limit: N-Tweed Heads. S-Eden.*	×	×	-	-	×	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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* EPBC	-	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.*	×	×	-	-	×	×
Brush-tailed Rock-wallaby *Petrogale penicillata* EPBC	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.*	×	×	-	-	×	×
Grey-headed Flying-fox *Pteropus poliocephalus* OEH EPBC	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.*	×	✓	✓	✓	✓	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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**	
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* OEH	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution Limit: N-North of Walgett. S-Sydney.*	✓	-	-	-	-	✓
East-coast Freetail Bat *Micronomus norfolkensis* OEH	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.*	×	✓	✓	✓	✓	✓
Large-eared Pied Bat *Chalinolobus dwyeri* OEH EPBC	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.*	×	marginal	×	✓	Not likely	×
Eastern Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	×	✓	×	×	low	✓
Little Bentwing-bat *Miniopterus australis* OEH	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.*	×	✓	✓	✓	✓	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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 Bentwing-bat *Miniopterus orianae oceanensis* OEH	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.*	✓	-	-	-	-	✓
Large-footed Myotis *Myotis macropus* OEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limits: N-Border Ranges National Park. S-South of Eden.*	✓	-	-	-	-	✓
Greater Broad-nosed Bat *Scoteanax rueppellii* OEH	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	✓	-	-	-	-	✓

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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**	
New Holland Mouse *Pseudomys novaehollandiae* EPBC	-	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.*	×	×	-	-	×	×
Cumberland Plain Land Snail *Meridolum corneovirens* OEH	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 Region.*	×	marginal	✓	✓	low	✓
Macquarie Perch *Macquaria australasica* EPBC	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.	×	×	-	-	×	×

Common name ***Scientific name*** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Preferred habitat** ***Distribution limit***	**Recorded on site (✓)**	**If not recorded on site**				**Considered in 7 part test of significance (✓) (Refer to Appendix 3)**
					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 Grayling *Prototroctes maraena* EPBC	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).	×	×	-	-	×	×

OEH	-	Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife*
EPBC	-	Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
V	-	Denotes vulnerable listed species under the relevant Act
E	-	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 subject site 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 A2.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A2.2.

Table A2.3 – Migratory fauna habitat assessment

Common name ***Scientific name***	**Preferred habitat** ***Migratory breeding***	**Suitable habitat present (✓)**	**Recorded on site (✓)**	**Comments**
Oriental or Horsfield's Cuckoo (*Cuculus optatus*)	It 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.	×	-	-
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. *Sedentary; dispersive.*	×	-	-
White-throated Needletail (*Hirundapus caudacutus*)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. *Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.*	✓	×	-
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.*	×	-	-
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.*	×	-	-
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*.	×	-	-
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.	×	-	-
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.*	×	-	-

Common name *Scientific name*	Preferred habitat *Migratory breeding*	Suitable habitat present (✓)	Recorded on site (✓)	Comments
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.*	×	-	-
Great Egret (*Ardea alba*)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. *Dispersive; cosmopolitan.*	✓	×	-
Cattle Egret (*Ardea ibis*)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. *Breeds in summer in warmer parts of range including NSW*.	✓	×	-
Latham's Snipe (*Gallinago hardwickii*)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.*	✓	×	-
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.*	✓	×	-

7 Part Test of Significance

A3

Council, or the authorising authority is required to consider the impact upon threatened species, populations and / or EECs from any development or activity via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed SIS.

The following 7 part test of significance relies on the survey results and ecological assessment provided in Sections 3 and 4 of this report and should be read as such. The potential impact is for the removal of 4.61ha of disturbed low condition CPW vegetation.

The current proposal avoids impacting 3.74 ha of degraded CPW vegetation. The impacted CPW vegetation is of low condition, has low species diversity and would also be expected to regenerate poorly. Past management of this site which has extended over a decade based on aerial photography has resulted in the low condition of the vegetation on the land.

Flora and fauna investigations and 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
Pimelea spicata	E1	✓	Direct – on potential habitat only. Likely to be on the marginal areas of the site like adjacent to fence lines that have been slashed less frequently.

Threatened fauna

Common Name	BC Act	Potential to occur	Potential impact
Yellow-bellied Sheathtail-bat	V	recorded	Direct – on potential roosting/breeding hollow and recorded foraging area
Eastern Bentwing-bat	V	recorded	Direct – on recorded foraging area
Large-footed Myotis	V	recorded	Direct – on potential roosting/breeding hollow and recorded foraging area
Greater Broad-nosed Bat	V	recorded	Direct – on potential roosting/breeding hollow and recorded foraging area
East-coast Freetail Bat	V	recorded (Gunninah)	Direct – on potential roosting/breeding hollow and recorded foraging area
Little Eagle	V	✓	Direct – on potential foraging area
Little Lorikeet	V	✓	Direct – on potential roosting/breeding hollow and potential foraging area
Swift Parrot	E	✓	Direct – on potential foraging area

Common Name	BC Act	Potential to occur	Potential impact
Dusky Woodswallow	V	✓	Direct – on low potential breeding and potential foraging area
Grey-headed Flying-fox	V	✓	Direct – on likely foraging area
Little Bentwing-bat	V	✓	Direct – on potential foraging area
Varied Sittella	V	✓	Direct – on low potential breeding and potential foraging area
Eastern Falsistrelle	V	low	Direct – on low potential breeding and potential foraging area
Cumberland Plain Land Snail	E	low	Direct – on low potential habitat
Spotted Harrier	V	unlikely	Direct – on unlikely potential foraging area
Square-tailed Kite	V	unlikely	Direct – on unlikely potential foraging area
Turquoise Parrot	V	unlikely	Direct – on unlikely potential foraging area
Powerful Owl	V	unlikely	Direct – on unlikely potential foraging area
Speckled Warbler	V	unlikely	Direct – on unlikely potential foraging area
Regent Honeyeater	E4A	unlikely	Direct – on unlikely potential foraging area

Endangered populations

- None for fauna
- None for flora

Endangered ecological communities

- Cumberland Plain Woodland

The 7 part test of significance is as follows:

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

The direct and indirect impacts of the proposal are considered within Section 5.2.

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

Greater Broad-nosed Bat (*Scoteanax rueppellii*), Large-footed Myotis (*Myotis macropus*), East-coast Freetail-bat (*Micronomus norfolkensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

These four microbat species are considered here collectively together due to their similar potential dependence on hollows for roosting and breeding. Whilst the selection of hollow types, sizes and microclimatic conditions varies between these species, the potential impacts on an important hollow and the subsequent assessment outcome is consistent for each.

The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, *Melaleuca* swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree lined creeks in open areas (Churchill, 2008). The Greater Broad-nosed Bat predominantly forages within open forest, woodlands, along vegetated creeklines and small river systems (Hoye and Richards, 1995). This species roost in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark as well as the roof of old buildings (Churchill 2008, Hoye & Richards 1995).

The Greater Broad-nosed Bat feeds on large slow flying beetles and moths (Dwyer 1965; Vestjens and Hall, 1977). This species is a slow flier and generally hunts for insects over understorey vegetation as well as foraging along the interface of clearings and paddocks with forested areas and along tree-lined creeks (Richards, 1988).

The Large-footed 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 Large-footed 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 East-coast Freetail 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 East-coast Freetail Bat species will utilize paddock trees and isolated remnant vegetation when in proximity to larger forest remnants (Allison, Hoye & Law, 2008). Cleared and semi-cleared landscapes are found to have higher activity levels than urban or forested landscapes. Riparian sites are also found to have high activity levels.

The Yellow-bellied Sheathtail-bat inhabits a wide variety of Eucalypt forests, foraging above the canopy in high flying, high speed movements (Richards, 2008). In mallee or open country it comes closer to the ground. Usually found in mixed sex groups of two to six and occasionally up to 30, the Yellow-bellied Sheathtail Bat roosts in large tree hollows and has been found in the abandoned nests of Sugar Gliders (Churchill, 2008).

A colony of six Yellow-bellied Sheathtail-bats were found roosting inside the trunk of a large hollow tree were clinging to the walls, hanging head down and propped up by their forearms; They were well separated but tended to cluster around the entrance hole (Churchill, 2008). Large maternity colonies may exceed 100 individuals. Occasionally it has been found resting on the walls of buildings in broad daylight, possibly due to exhaustion from migratory habits or disease.

Hollows present within the proposed R2 Residential landscape should be inspected for the presence of roosting by recorded threatened microbat species. This includes only two recorded trees. If any hollows within these trees are found to contain a threatened microbat roost (which is not expected), then this tree is to be retained with appropriate buffers from the development landscape. The same inspections and protections are required for any hollow-bearing trees located within a proposed building footprint located within the proposed E3 area.

According to DEC (2004) survey Guidelines, stag-watching of all trees should be undertaken during warmer months (October - March). Outside of this period microbats may become dormant during cooler months therefore tree climbing inspections with use of a videoscope should be undertaken at this time to effectively determine presence and use of hollows.

In the event that no activity is recorded, 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 not previously recorded within these hollows. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled for relocation and all hollows should be inspected for occupation, signs of previous activity and potential for reuse.

Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse. In the instance of recording the presence of threatened microbats during tree removal, maximum effort should ensure safe relocation of the roosting colony.

Re-used hollows or those with likely occupation are to be relocated to the E3 lands. All other hollows removed should be replaced with nest boxes. Relocated hollows are preferred instead of bat boxes for the identified microbat species. Boxes should be constructed all of weatherproof timber (marine ply), fasteners and external paint.

Provided the above mitigation measures are undertaken with respect to threatened hollow-dependent microbats, the proposal will not likely cause a significant impact on the local population of these species.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

There are no endangered fauna populations previously recorded within 10km of the study area or expected to occur.

There is one endangered flora population within the Campbelltown LGA, These are:

- *Marsdenia viridiflora* subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs

Despite detailed searches undertaken for this species within the subject site, no specimens were located.

Therefore, it is considered that the action proposed is not likely to have an adverse effect on the life cycle of these species that constitute the endangered populations such that a viable local population of these species is likely to be placed at risk of extinction.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

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

One (1) CEEC – Cumberland Plain Woodland – was observed within the study area. Vegetation on the eastern side of the easement is heavily impacted, however the density of trees is higher and the ground layer does not appear to be ploughed as frequently or as low

as the western side, allowing for greater species diversity and more regrowth. The western side of the easement north of the existing dwelling is heavily ploughed with little or no mid-storey regrowth and the native species diversity is lower. There has been some past removal of trees across the site but more obvious on the western side as the density of trees is a bit lower.

Throughout the site there has been some pasture improvement, therefore the ground layer may have only moderate levels of native species with introduced grasses often outcompeting native herbs and grasses.

The study area does form part of an extensive corridor that occurs in the local area over approximately 4.5km from Raby Road to Varroville Road. The vegetation in the eastern portion of the site is key to maintenance of the corridor and the new adjoining development to the north has provided a corridor of vegetation running either side of the electrical easement. If the eastern side of the site is not retained for a corridor, the usage value would be severely diminished.

Cumberland Plain Woodland impacted by the proposed R2 zone is 4.61ha of low condition vegetation consisting of 3.41ha of moderate canopy and 1.2ha of sparse canopy. A total of

The proposed rezoning to R2 for the western portion would likely impact (in the future) 4.61ha of disturbed low condition Cumberland Plain Woodland. Rezoning the eastern portion to E3 would see retention of the 3.74ha inclusive of stormwater basins and a dwelling with APZ. A total of approximately 4.71ha in total to be protected and restored.

The western portion of proposed R2 area whilst part of a vegetated corridor, is only supplementary to the corridor, but not essential to its functioning capacity. All surrounding allotments with native vegetation all contain Cumberland Plain Woodland and mostly zoned E3. The recently developed lots to the north are part of the south-west growth centres area. The retained E3 zoned land assists in protecting remnant Cumberland Plain Woodland in the locality and biodiversity offsetting provides a mechanism for creating a better ecological outcome within and off the site.

The impacted vegetation will not isolate or fragment the CEEC, break connectivity or destroy its functioning. As such, the proposal is unlikely to have an adverse effect on the extent of Cumberland Plain Woodland such that its local occurrence is likely to be placed at risk of extinction.

ii. Is likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction,

4.61 ha within the lands west of the powerline easement and limited impact on the remaining 3.574 ha to the south-east of the powerline easement.

It is unlikely that the proposed development will adversely modify the composition of this community such that its local occurrence is likely to be placed at risk of extinction.

d) In relation to the habitat of threatened species, populations or ecological community:

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Pimelea spicata*, Cumberland Plains Woodland, Spotted Harrier, Little Eagle, Square-tailed Kite, Little Lorikeet, Swift Parrot, Turquoise Parrot, Powerful Owl, Speckled Warbler, Regent Honeyeater, Varied Sittella, Dusky Woodswallow, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Eastern Falsistrelle, Little Bentwing-

bat, Eastern Bentwing-bat, Large-footed Myotis, Greater Broad-nosed Bat and Cumberland Plain Land Snail.

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

The subject site has an area of 14 ha, which comprises approximately 8.35 ha of disturbed native vegetation. The proposed vegetation removal is likely to remove 4.61ha of disturbed low condition native vegetation in the western portion of the site. The vegetation to be impacted will have partial to good quality 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 action, and

The managed woodland vegetation within the study area contributes to local connectivity towards the immediate south and then east. The combined local connective landscape is however already isolated from other major remnants or contiguous vegetation including any major conservation parks or reserves.

Whilst the study area does provide some degree of canopy only connectivity to this local remnant, removal of vegetation within the study area will not cause any segmentation, fragmentation or isolation of this local connectivity. This is demonstrated in Figure 4 in Section 4.4.

The connectivity that will be maintained to the immediate south is represented by better quality unmanaged native vegetation able to support small terrestrial animal species and their habitats.

Threatened fauna species recorded during fauna survey or otherwise within the local connective landscape include the Cumberland Plain Land Snail, Greater Broad-nosed Bat, Large-footed Myotis, Eastern Bentwing-bat, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Grey-headed Flying-fox, Varied Sittella, Little Lorikeet and Little Eagle. Each of these are highly mobile flying species with the exception of the Cumberland Plain Land Snail, which was not found within the study area and is unlikely to occur. The removal of habitat for the proposed vegetation removal will not likely inhibit or reduce local movements for any of these remaining flying species.

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, population or ecological community in the locality

In respect to threatened fauna species recorded, the hollows present may have importance for roosting and breeding. Subsequent mitigation measures including inspections of these hollows are advised in order to protect any threatened roosting bat colony.

The area of impact associated with the proposed vegetation removal is not likely of high quality, of any breeding importance or central to the home range requirements of any remaining threatened fauna species considered such that behaviour or ecology of these species will be significantly altered in any way.

Whilst the importance of the Cumberland Plain Woodland is high given it is a critically endangered ecological community, the removal of the western portion of the remnant on site will not break the connective value of the community as it is abundant locally, and protected within adjoining E3 environmental management zoning.

With respect to threatened flora, no specimens have been detected. The western portion of the site does not appear to provide suitable habitat for any species. The eastern portion may provide small amounts of potential habitat for *Pimelea spicata* in areas of limited disturbance such as along some boundaries and fence lines.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The site has not been identified as critical habitat within the provisions of the *TSC Act*. Therefore this matter does not require any further consideration at this time.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Approved state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*)) (DEC 2006)
- *Pimelea spicata* (DEC 2004)
- Cumberland Plain Recovery Plan (DECC 2010)

It is considered that the proposed vegetation removal is generally consistent with the objectives or actions of the above-mentioned draft and approved recovery plans.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined in the *TSC Act* 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 under the *TSC Act*, 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			✓

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**
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 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.

Aggressive exclusion of birds by Noisy Miners (Manorina melanocephala)

Noisy Miners have been recorded present within the study area. It is likely that Noisy Miners from within the study area may be slightly displaced as a result of habitat removal for the proposed vegetation removal, resulting in increased impacts from this species on other native birds in the nearby surrounds. Given the high degree of disturbance in the local surrounds it is expected that the Noisy Miner is already at impacting numbers in these areas.

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. Whilst almost insignificant in size, the proposal is part of the accumulative effect and thus should be considered as contributing to this threatening process.

Clearing of native vegetation

The proposed rezoning would likely impact (in the future) 4.61ha of Cumberland Plain Woodland. Restoration of CPW within the proposed E3 lands estimated at 4.71ha and offsetting is recommended to mitigate the clearing of vegetation.

Competition and grazing by the feral European rabbit

It is expected that the proposed vegetation removal will increase or decrease the potential for rabbit invasion. Rabbit management and control such as through exclusion fencing, destruction of warrens and target "Pindone" baiting is recommended as a standard protocol.

Forest Eucalypt dieback associated with over-abundant psyllids and bell miners

The study area consists of woodland patches subject to existing impacts of Bell Miners. The study area is however already devoid of any likely breeding potential due to the absence of understorey and scrub vegetation for nesting. The proposal is unlikely to significantly enhance the effect of this threatening process of displace the Bell Miners into additional areas.

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.

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.

Invasion and establishment of exotic vines and scramblers

Without a vegetation management plan or equivalent, the edge effects caused by the proposed residential development may increase the potential for species such as Moth Vine or Blackberry to become more dominant features of the proposed conservation portion of the site.

Invasion of native plant communities by Scotch Broom (*Cytisus scoparius*)

This species is present on the subject site. The proposed vegetation removal may provide an opportunity to ameliorate the effect of this key threatening process by the application of suitable weed control measures.

Invasion of native plant communities by Lantana (*Lantana camara*)

This species is present on the subject site. The proposed vegetation removal may provide an opportunity to ameliorate the effect of this key threatening process by the application of suitable weed control measures.

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 *Pennisetum clandestinum* (Kikuyu) and similar perennial grasses. Much of the site has previously been pasture improved and has replaced native grasses. However the management of this threatening process can be achieved through the imposition of a vegetation management plan or similar will assist in control of exotic perennial grasses.

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

This species is present on the subject site. The proposed vegetation removal may provide an opportunity to ameliorate the effect of this key threatening process by the application of suitable weed control measures.

Loss of hollow-bearing trees

Hollow-bearing tree surveys identified two hollow-bearing trees containing medium (10-30cm) and small (0-10cm) sized hollows within the north-western portions of the study area. The proposal will require the removal of these hollow-bearing trees 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 Little Lorikeet, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Eastern Falsistrelle, Large-footed Myotis and Greater Broad-nosed Bat. Four of the abovementioned five microbat species were recorded during surveys undertaken. The relocation or replacement of hollows removed with refurbish hollows or nesting boxes placed within the conservation areas of the site is recommended as an appropriate means to supplement the loss of natural hollows.

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

Retained vegetation in the eastern portion of the site may be impacted by garden escapes by adjoining properties. Similarly, adjoining existing E3 lands to the south of the site may be impacted by dumped garden escapes, creepers, bulbs and seed blow in.

Residents could be encouraged to plant native endemic species. Control of access to retained vegetation areas is important to limit this type of impact. Weed control should also be undertaken in retained vegetation areas on a regular basis.

Predation by feral cat (Felis catus)

The proposed vegetation removal may alter impacts on adjoining lands by increasing the numbers of domestic cat ownership and as such the action proposed may increase the impact of this threatening process.

Removal of dead wood and dead trees

The proposed vegetation removal will 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 with potential habitat within the subject site and likely dependent on dead wood or dead trees include Speckled Warbler, Varied Sittella, Dusky Woodswallow and Cumberland Plain Land Snail. None of these species have been recorded to date within the study area. 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

A4

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.