Travers

bushfire & ecology

ecological constraints assessment

Richmond Road
Clarendon

September 2012
(REF: A12076)

Ecological Constraints Assessment

Proposed Commercial Facilities
Richmond Road, Clarendon

September 2012

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

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Executive Summary

This Ecological Constraints Report has been prepared by *Travers bushfire & ecology* to identify the ecological constraints of a mostly cleared and managed a 75ha property to be considered for future development.

The study area, upon which development is to be considered, includes Lots 1 & 3 DP 700263, Lot 2 DP 629053, Lot F DP 161499 & Lot C DP 160847 Richmond Road, Clarendon and is located between Windsor Country Golf Club and Hawkesbury Racecourse.

Recorded threatened flora, fauna & EECs

Ecological survey and habitat 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*, two (2) threatened fauna species Eastern Bentwing-bat (*Miniopterus orianae oceansis*) and Large-footed Myotis (*Myotis macropus*), no threatened flora species, and three (3) Endangered Ecological Communities (EECs), Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands were recorded within or in close proximity to the study area.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, no threatened fauna species, two (2) protected migratory bird species Cattle Egret (*Ardea ibis*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*), no threatened flora species, and one (1) EEC listed under this Act, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest were recorded within or in close proximity to the study area.

In respect of matters relative to the *Fisheries Management Act 1994*, no threatened fish species have been previously recorded within the Rickabys Creek catchment. It is however considered that this creek (which runs along the eastern and southern extent of the study area) provides potential habitat for the Macquarie Perch. Threatened fish species will not offer a constraint to development provided that there will be no detrimental effect on water quality, water quantity, direct impacts upon riparian habitat or any obstructions to fish passage.

Ecological constraints

The ecological constraints for this site pertain to the following ecological and mapped features:-

- Rickabys Creek is identified (in part) as Wetland 145 under the State regional Environmental Planning policy as a wetland.
- Important migratory and threatened species habitat mostly contained with the mapped Wetland 145.
- Endangered ecological communities also within and immediately adjoining the SREP 20 wetland area.

These constraints are discussed in more detail below. However it is recognised that these ecological constraints mostly lie within flood affected portions of the landscape and are unlikely in themselves to be a constraint to development due to flooding restrictions on the landscape.

However, future development applications will need to address these matters as part of reporting pertaining to ecological, stormwater management and planning matters for the site.

SREP 20 Hawkesbury Nepean River

The low lying areas of Rickabys Creek are a mapped as environmentally sensitive areas (wetlands) as a result of SREP 20 wetland mapping which has identified these areas as a Wetland 145. This wetland starts at the Blacktown – Richmond Railway and heads south along the creek line for more than 2km. It will provide a significant constraint to the lower lying lands within the study area. This area is also likely to be part of mapped flood zones.

The constraints that apply with a SREP 20 Wetland have multiple considerations such as:-

- The boundary of the wetland is a legislative trigger for preparation of an environmental impact statement for any perceived impacts on the wetland area
- A buffer of up to 100m may apply to the wetland boundary subject to slopes and other associated constraints
- The water quality of the receiving waters must be maintained or improved
- Surface and groundwater dependent ecosystems should not be adversely affected as a result of changes in surface or groundwater flows
- Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced
- Scenic quality is to be protected

There are up to twelve (12) SREP 20 policies that need to be addressed in accordance with stipulated strategies which make the river and the wetland of prime importance and it may lead to requirements to undertake appropriate restoration works to maintain or improve the quality of the riverine and wetland landscape.

Waterbird Habitat

The extensive open water habitats and associated shallows and floodplain fringes provide high quality open habitat for wading birds and waterfowl including migratory and threatened species. The recorded waterbird diversity during survey was particularly high and this habitat is expected to be utilised by other species on a seasonal basis.

In addition to the open water habitat values within the study area, Figure 1 identifies important shoreline / floodplain habitat areas for wading birds. Appropriate setbacks from open water and shoreline foraging areas would depend on proposed revegetation measures. A reduced setback would be appropriate where a restored vegetation fringe to these areas is proposed. The most important bird habitat areas identified on Figure 1 are confined within the SREP 20 Wetlands area (see below).

The Curlew Sandpiper, endangered under state legislation, has been previously recorded within the study area. Several other threatened wading birds or waterfowl have been recorded utilising similar habitats in the nearby locality (out to 2km) many of which have not been recorded recently (in the last 8-10 years). These include Freckled Duck, Black-necked Stork, Australasian Bittern, Black Bittern and Australian Painted Snipe.

Furthermore, additional migratory birds listed under the JAMBA, CAMBA or ROKAMBA agreements including Cattle Egret, Pacific Golden Plover, Sharp-tailed Sandpiper, Pectoral Sandpiper, Latham's Snipe, Little Curlew and Common Greenshank have been recorded to a reference point within the study area. The accuracy of these records suggest that the reference point is not accurate however the quality of habitat along the Rickabys Creek portion within the study area is most suitable for these species as compared to elsewhere in the immediate locality.

Whilst other threatened species may also utilise the dam resource, the steep edges resultant from damming has resulted in a lowering of foraging value around the fringes for smaller waders. Use by waders should not be ruled out particularly given the large size and the proximate protected location to Rickabys Creek.

Recorded threatened and protected fauna species

The open water habitats of Rickabys Creek and the large dam present also provide foraging habitat for the recorded nationally significant White-bellied Sea Eagle and threatened Large-footed Myotis. These two species are dependent on open water-bodies for the majority of their foraging diet and survival. The recorded nationally significant Cattle Egret and threatened Eastern Bentwing-bat will also utilise the open water habitats and their fringes, however these species are unlikely to be highly dependent on the study area, based on the availability of extensive local habitat.

The Large-footed Myotis is also a hollow-dependent microbat species and therefore the loss of hollows close to open water habitat would be an issue for ecological assessment purposes.

Endangered Ecological Communities (EEC)

The EECs including *Cumberland Plain Woodland*, *River-flat Eucalypt Forest on Coastal Floodplains* and *Freshwater Wetlands* occur generally on the perimeter of the study area. Along Rickabys Creek there is some remnant vegetation, although it is mostly on the Golf Course side of the creek. It comprises almost exclusively of Swamp Oak trees in the north (Eucalypts would have been removed in the past) and a combination of Swamp Oaks, Eucalypts and shrub species to the south-west. This vegetation is commensurate with the EEC0 - River-flat Eucalypt Forest on Coastal Floodplains. It occupies a total area of approximately 0.57ha.

There is an area of Freshwater Wetlands EEC off Rickabys Creek along the southern site perimeter in association with a small inlet off the creek which appears to remain wet or damp for most of the year and an adjacent small patch of sedges in a damp swale approximately 1.05ha in size.

The Cumberland Plain Woodland EEC occurs on the western boundary of the study area and occupies an area of approximately 0.42ha in size.

The River-flat Eucalypt Forest and Freshwater Wetlands are on flood constrained lands and would be unlikely to be developed for that reason alone unless used as recreational or open space. Rickabys Creek would also need to be protected and managed in accordance with the NSW Office of Water *Controlled Activity Guidelines, 2012.*

The Cumberland Plain Woodland is on slightly higher ground and may be less flood affected, however, the existing dams restrict access to the existing vegetation. This area lends itself to being a restoration area for Cumberland Plain Woodland. Cumberland Plain Woodland is critically endangered and should be retained and restored where possible.

Conclusion

From this review, large portions of the cleared and managed pasture areas are ecologically unconstrained and suitable for development due to the lack of native vegetation, absence of habitat features, and absence of fringing habitat to water bodies. Development areas are more constrained by potential flooding and are unlikely to result in an impact on any of the observed ecologically sensitive areas.

There is a however a significant constraint to development on the lower lying lands due to the protection of wetlands covered under SREP 20 (Figure 1).

The large water body within the site provides a feeding resource for wading birds as well as a resource for microbat species such as the Large-footed Myotis. It is thus recommended that the largest water body is retained insitu without any significant change except for beautification or stormwater management purposes.

It is expected that the River-flat Eucalypt Forest and Freshwater Wetlands EECs are unlikely to be developable due to flooding constraints. The Cumberland Plain Woodland is also situated in an impractical place for development.

As there were no threatened species observed, there are no further threatened flora constraints.

Any development on this land would be expected to aim to provide sufficient setbacks from ecologically sensitive land and to involve a significant level of potential revegetation works to aim to improve the local landscape particularly adjoining the mapped SREP 20 wetlands.

Modest planting programs would result in significant ecological gains onsite for all three of the listed EECs and can be used as a viable argument for some form of development on site.

Setbacks to ecologically sensitive areas potentially include:

- Provision of setbacks to the SREP 20 Wetland, open water and important habitat in shoreline areas (mostly contained within flood-prone areas) and in accordance with the NSW Office of Water *Controlled Activity Guidelines 2012*.
- Setbacks to Rickabys Creek in line with the NSW Office of Water *Controlled Activity Guidelines 2012* including no development within the SREP 20 area
- Protection of Cumberland Plain Woodland on the western boundary.

It is expected that any landscape management of the floodplain areas would involve:

- Provision of a buffer between the proposed development and SREP 20 wetlands of up to 100m
- Revegetation along the riparian fringes of Rickabys Creek
- Replanting around the existing water bodies to enhance fringing habitat areas
- Future landscape planting should incorporate the use of locally occurring species that are naturally found within Cumberland Plain Woodland or River-flat Eucalypt Forest communities.

Any of the above measures may or may not apply subject to the extent and type of proposed development.

Glossary of terms

APZ	asset protection zone
BPA	bushfire protection assessment
CLUMP	conservation land use management plan
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from 4/07)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from 10/09)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from 4/11)
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 1994*
FMP	fuel management plan
HTA	habitat tree assessment
IPA	inner protection area
LEP	Local Environment Plan
LGA	local government area
NES	national environmental significance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	*Planning for Bush Fire Protection 2006: A Guide for Councils, Planners, Fire Authorities and Developers*
POM	plan of management
RF Act	*Rural Fires Act*
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*

SEWPAC	Federal Department of Sustainability, Environment, Water, Population and Communities
SIS	species impact statement
SULE	safe useful life expectancy
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act 1995*
VMP	vegetation management plan

Table of Contents

Figures

Tables

Appendices

Introduction 1

Travers bushfire & ecology has been engaged by to identify the potential ecological constraints upon existing rural allotments off Richmond Road at Clarendon for the purposes of an unknown proposed development. The northern most portion of the site is proposed to be used as a Masters home improvement centre.

Subject to feasibility studies the southern portion of the lands is proposed to be used for warehouse or similar style of development. However this ecological constraints assessment does not assume the type of development and has identified constraints irrespective of a proposed use.

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)
- Identify ecological constraints based on a preliminary ecological survey, existing threatened species databases and mapped constraints

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act 1995

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* (EPA 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

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

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 Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) 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.

Threshold criteria apply to specific NES matters which may determine whether a referral is or are not required, such as for the EPBC listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with SEWPAC 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 Proposed works

The study area is currently being investigated for development potential inclusive of retail warehouse facilities.

1.4 Site description

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

Table 1.1 – Site features

Location	Lots 1 & 3 DP 700263, Lot 2 DP 629053, Lot F DP 161499 & Lot C DP 160847 Richmond Road, Clarendon
Local government area	Hawkesbury City Council
Grid reference	295470E 6278220N
Elevation	5-10m AMSL
Topography	Situated on mostly flat landscape.
Geology and soils	Geology; Majority of the site is on Qpd – Clarendon Formation – quaternary clay, clayey sand, silt. Tr in the creek line – tertiary conglomerate, matrix supported, and Tl on higher ground to the west, tertiary clay, patches of ferruginized consolidated sand. Soils; Richmond Soil Landscape – fluvial soils which are poorly structured in the north, Upper Castlereagh Soil Landscape – fluvial soils, deep soils which are dispersible and have impermeable subsoils in the west, and South Creek Soil Landscape – fluvial soils with deep layered sediments over bedrock or relict soils along Rickabys Creek.
Catchment & drainage	The study area is located along approximately 2km of the western banks of Rickabys Creek approximately 2.7km upstream from its intersection with the Hawkesbury River. Low floodplain mudflats extend into the study area along this portion of Rickabys Creek. A large dam has been constructed within the central-southern portions of the study area which would have previously formed a large wetland area adjacent to Rickabys Creek.
Vegetation	Pasture grasses with some riparian vegetation along Rickabys Creek and a patch of Cumberland Plain Woodland adjacent to the western boundary. There are some water bodies on site that have some fringing aquatic vegetation. Occasional trees occur in the northern paddocks and there are some planted trees and shrubs in close proximity to the existing dwellings and sheds.
Existing land use	Grazing
Clearing	The majority of the study area has been previously cleared for farming land uses.

Survey Methodology 2

2.1 Survey constraints

It is important to note that field survey data collected during the survey period is representative of species occurring within the study area 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 study area outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to overcome this survey limitation.

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

A review of the relevant information pertinent to the study area 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 / NearMaps*)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act 1995 (TSC Act)*
- *Fisheries Management Act 1994 (FM Act)*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*
- Rare or Threatened Australian Plants (ROTAP)
- The natural vegetation maps for the study area including Vegetation Mapping of the Cumberland Plain (NPWS 2002)

Desktop Assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the study area, 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 2012) 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 SEWPAC *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 as per the *Atlas of NSW Wildlife* search. These two searches, in combination, 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 Section 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: S10359.

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.

2.3 Flora survey methodology

A review of the *Atlas of NSW Wildlife* database (OEH 2012) was undertaken prior to the site visit to determine threatened species previously recorded within 10km of the subject site.

North-western portion of the study area:

Given the lack of native vegetation, botanical survey was undertaken on 1 May 2012 over a time frame of approximately 1.5hrs. No fauna survey was undertaken except for the purposes of identifying the types of fauna habitat present.

Botanical survey included a random meander in accordance with *Cropper* (1993) to gain a full species list of the plants within the site, and then two (2) quadrats of 0.04ha were undertaken.

Remainder of study area:

Botanical survey was undertaken across the remainder of the site on 27 July 2012 over a 4hr time period in all remnant patches of vegetation with some random meanders across the paddocks. Three (3) quadrats were placed in the southern section of the study area and target searches for *Pimelea spicata* were undertaken where applicable within these southern remnants of vegetation. Given the lack of native understorey, the potential for occurrence was thought to be low.

Transects were also undertaken to account for fringing vegetation to water bodies and thin linear pieces of vegetation along Rickabys Creek.

2.4 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions is outlined in Table 2.1 and depicted on Figure 1.

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 2.6.

2.5 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the study area.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	26/7/12	6/8 cloud, nil-light NW wind, no rain, temp 20-16^{o}C	Diurnal opportunistic / spotting scope / census	4hrs 1330 - 1730
Nocturnal birds	26/7/12	7/8 cloud, no wind, no rain, temp 15-13^{o}C	Spotlighting Call playback (Section 2.6 species)	1hr 30min 1730 - 1900 commenced @ 1750
Arboreal mammals	26/7/12	7/8 cloud, no wind, no rain, temp 15-13^{o}C	Spotlighting Call playback (Section 2.6 species)	1hr 30min 1730 - 1900 commenced @ 1810
Terrestrial mammals	26/7/12	7/8 cloud, no wind, no rain, temp 15-13^{o}C	Spotlighting	1hr 30min 1730 - 1900
Bats	26/7/12	7/8 cloud, no wind, no rain, temp 15-13^{o}C	Spotlighting Anabat II (Passive monitoring)	1hr 30min 1730 - 1900 o'night from 1720
Reptiles	26/7/12	6/8 cloud, nil-light NW wind, no rain, temp 20-16^{o}C	Habitat search, opportunistic	4hrs 1330 - 1730
Amphibians	26/7/12	7/8 cloud, no wind, no rain, temp 15-13^{o}C	Spotlighting & call identification	1hr 30min 1730 - 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 Vegetation condition assessment – Biometric field method	1/5/12 and 27/7/12
Stratified sampling	20x20 metre quadrats in remnant vegetation and paddocks with transects undertaken along various gradients, adjacent to water bodies or in thin remnants of vegetation	1/5/12 and 27/7/12
Target searches	Target searches in known or preferred habitats	1/5/12 and 27/7/12

2.6 Site specific survey techniques

Diurnal birds

One (1) diurnal bird census point was undertaken within the Grey Box Woodland vegetation community located in the southern portions of the study area (see Figure 1). A minimum of 20 minutes of survey was undertaken at this census point in an area radiating out to 40m.

Five (5) spotting scope outlook stations were undertaken to identify wetland birds from different vantage points. The spotting scope to x 47 magnification is placed on a tripod for stable long-distance views.

Opportunistic diurnal bird survey was conducted between census and spotting scope points and whilst undertaking other diurnal surveys.

Nocturnal birds

Given the suitability of habitat present, Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*) were targeted by call-playback techniques.

Arboreal and terrestrial mammals

Given the low suitability of habitat present, Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by call-playback techniques.

Habitat Trees

Hollow-bearing trees were identified within the study area. 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.

2.7 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the study area 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 study area outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

Flora survey limitations

Given that the majority of site is utilised for grazing, there is little structured native vegetation present onsite. The site boundary was clear, delineated by either fencing or the creek line and as such, survey area was well defined.

Some vegetation in close proximity to the existing dwellings and sheds was not accounted for as it was almost entirely planted, had little ecological value, and was not likely to support any threatened flora species habitat.

Fauna survey limitations

The wetland edges in the study area are considered to be of high quality habitat for wading birds that are likely to visit the area seasonally and as part of migratory movements. The single day of survey provides only a snapshot of recorded wetland birds present. Whilst the recorded number of waders and waterfowl was considerably high at this time, it is expected that a number of other birds, and particularly the potential for rare migratory species, would utilise these habitats on other occasions.

The fauna survey was undertaken during winter. Microbat activity is significantly less during this time when a number of species are hibernating or in a frequent state of torpor. Given the large area of available surface water present on site and within Rickabys Creek, it is expected that the site will be used for foraging and drinking during warmer months. Other threatened microbat species may be more commonly present at this time.

Further survey for microbats is however not considered to be necessary as the survey undertaken to date has already identified the value of the dams present for foraging by the threatened Large-footed Myotis.

Survey Results 3

3.1 Flora results

3.1.1 Flora species

The plants observed within the vegetation communities of the study area are listed in Table 3.1 below. Note that the majority of landscaping species have not been included in the table.

Table 3.1 – Flora observations for the study area

Family	Scientific Name	Common Name
Trees		
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Myrtaceae	*Corymbia citriodora*	Lemon-scented Gum
Myrtaceae	*Eucalyptus moluccana*	Grey Box
Myrtaceae	*Eucalyptus* sp.	-
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Fabaceae	*Gleditsia triacanthos**	Honey Locust
Proteaceae	*Grevillea robusta*	Silky Oak
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda
Myrtaceae	*Lophostemon confertus*	Brush Box
Myrtaceae	*Melaleuca decora*	-
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
Meliaceae	*Melia azedarach* var. *australasica*	White Cedar
Anacardiaceae	*Schinus molle* var. *areira**	Pepper Tree
Shrubs		
Mimosaceae	*Albizia* sp.*	-
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Native Blackthorn
Solanaceae	*Cestrum parqui**	Chilean Cestrum
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Solanaceae	*Lycium ferocissimum**	African Boxthorn
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive
Euphorbiaceae	*Ricinus communis**	Castor Oil Plant
Rosaceae	*Rosa rubignosa**	Sweet Briar
Rosaceae	*Rubus fruticosus* sp. agg.*	Blackberry Complex
Rosaceae	*Rubus parvifolius*	Native Raspberry
Solanaceae	*Solanum linnaeanum**	Apple-of-Sodom
Solanaceae	*Solanum mauritianum**	Wild Tobacco
Groundcovers		
Amaranthaceae	*Alternanthera pungens*	-

Table 3.1 – Flora observations for the study area

Family	Scientific Name	Common Name
Amaranthaceae	*Amaranthus viridis**	Green Amaranth
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel
Chenopodiaceae	*Atriplex prostrata**	Saltbush
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass
Azollaceae	*Azolla pinnata*	Ferny Azolla
Cyperaceae	*Baumea acuta*	-
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Cyperaceae	*Bolboschoenus fluviatilis*	Marsh Clubrush
Brassicaceae	*Brassica rapa**	Wild Turnip
Asphodelaceae	*Bulbine bulbosa*	Bulbine Lily
Apiaceae	*Centella asiatica*	Indian Pennywort
Poaceae	*Chloris gayana**	Rhodes Grass
Asteraceae	*Cirsium vulgare**	Spear Thistle
Commelinaceae	*Commelina cyanea*	Native Wandering Jew
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane
Asteraceae	*Conyza sumatrensis**	Fleabane
Apiaceae	*Cyclospermum leptophyllum**	Slender Celery
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus brevifolius**	Mullumbimby Couch
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Cyperus imbecilis*	-
Cyperaceae	*Cyperus rotundatus**	-
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia polygonoides*	-
Poaceae	*Eragrostis curvula**	African Lovegrass
Euphorbiaceae	*Euphorbia peplus**	Spurge
Apiaceae	*Foeniculum vulgare**	Fennel
Fumariaceae	*Fumaria muralis**	Wall Fumitory
Rubiaceae	*Galium aparine**	Cleavers
Asteraceae	*Hypochaeris radicata**	Flatweed
Juncaceae	*Juncus usitatus*	Common Rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Fabaceae	*Lotus suaveolans**	Hairy Bird's Foot Trefoil
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose
Malvaceae	*Malva sylvestris**	Tall Mallow
Marsileaceae	*Marsilea hirsuta*	Nardoo
Fabaceae	*Medicago polymorpha**	Burr Medic
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Liliaceae	*Nothoscordum borbonicum**	Onion Weed
Oxalidaceae	*Oxalis exilis*	-
Oxalidaceae	*Oxalis perennans*	-
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Pennisetum clandestinum**	Kikuyu
Philydraceae	*Philydrum lanuginosum*	Woolly Frogmouth
Poaceae	*Phragmites australis*	Common Reed
Plantaginaceae	*Plantago lanceolata**	Ribwort

Table 3.1 – Flora observations for the study area

Family	Scientific Name	Common Name
Polygonaceae	*Rumex brownii*	Swamp Dock
Polygonaceae	*Rumex crispus**	Curled Dock
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Solanaceae	*Solanum nigrum**	Black Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Solanaceae	*Solanum pseudocapsicum**	-
Asteraceae	*Soliva pterosperma**	Bindii
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Poaceae	*Sporobolus africanus**	Parramatta Grass
Asteraceae	*Taraxacum officinale**	Dandelion
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Fabaceae	*Trifolium repens**	White Clover
Juncaginaceae	*Triglochin microtuberosum*	Water Ribbons
Typhaceae	*Typha orientalis*	Cumbungi
Urticaceae	*Urtica incisa*	Stinging Nettle
Verbenaceae	*Verbena bonariensis**	Purpletop
Verbenaceae	*Verbena rigida**	Veined Verbena
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell
Campanulaceae	*Wahlenbergia stricta* subsp. *stricta*	Austral Bluebell
Vines		
Apocnyaceae	*Araujia sericifera**	Mothvine
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper
Sapindaceae	*Cardiospermum grandiflorum**	Balloon Vine, Love in a Puff
Chenopodiaceae	*Einadia nutans* subsp. *linifolia*	Climbing Saltbush
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Vicia sativa* subsp. *sativa**	Common Vetch
*** indicates an exotic species**		

3.1.2 Vegetation communities

The following areas of vegetation have been identified within the study area:-

- Cleared and Managed Pasture
- Riparian Open Woodland
- Constructed Dams
- Freshwater Wetlands
- Grey Box Woodland

Cleared and Managed Pasture

Cleared or managed pasture occurs across more than 90% of the study area which contains a handful of trees, both native and planted. The majority of native tree specimens are *Melia azedarch* (White Cedar). Most of the paddocks are grazed by horses and cattle. Cleared or managed pasture is unlikely to contain threatened flora.

Photo 1 – The two trees and dam present within the study area

Photo 2 – Eastern section of the study area looking north-easterly from the largest dam

Very few native species were observed within this vegetation community, with native species generally comprising less than 10% of the ground cover.

Common exotic species include *Pennisetum clandestinum, Trifolium repens, Modiola carolinana, Sida rhombifolia, Malva sylvestris, Taraxacum officinale, Cirsium vulgare* and *Plantago lanceolata.*

Riparian Open Woodland

This vegetation community occurs along the perimeter of Rickabys Creek. There was a small amount of native vegetation present up to approximately 10m from the creek edge. The vegetation is managed via slashing and / or grazing activities in the most part and contains limited native ground cover and mid-storey species. There were some native Wattles and Blackthorn in the far south in the vicinity of Transect 3.

Common native canopy species included *Casuarina glauca* (Swamp Oak) up to a height of 12-15m. These were generally sparse or occasionally higher in density.

Photo 3 – Riparian Open Woodland near the south-western corner of the study area

Photo 4 – Riparian Open Woodland along Rickabys Creek at the southern end of Transect 4

The mid-storey was largely absent except for the far southern reaches of the study area. Mid-storey species include *Melaleuca linariifolia, Melaleuca styphelioides, Acacia floribunda, Acacia falcata, Acacia parramattensis* and *Bursaria spinosa.*

The ground layer of vegetation contained varying levels of native species, however, it was rare that these comprised any more than 25% of the projected foliage cover. The most encountered species include *Microlaena stipoides* var. *stipoides, Rubus parvifolius, Hypolepis muelleri.*

Whilst this community has no Eucalypts present, the presence of various Acacias and Bursaria would be more common to a River-flat Eucalypt Forest as opposed to a Swamp Oak Woodland. It is likely that the almost tree-less property once contained *Eucalyptus tereticornis* (Forest Red Gum) along the lowlands which was occasionally evident in the golf course lands immediately east. As such, the Riparian Open Woodland is a poor quality representation of the endangered ecological community (EEC) - River-flat Eucalypt Forest on Coastal Floodplains.

Constructed Dams

Constructed dams are present at a number of locations with one extensive dam within the southern portion of the study area. Constructed dams are not recognised as the equivalent EEC Sydney Freshwater Wetlands. Only the largest dam had any significant vegetation present around its perimeter. The others had a few intermittent sedge species or were devoid of vegetation.

Common sedge species include *Typha orientalis, Ludwigia peploides, Azolla pinnata* and *Philydrum lanuginosum.*further species may be present but access was limited.

Photo 5 – The largest water body looking easterly

Photo 6 – The largest water body looking westerly

Freshwater Wetlands

Although small and relatively inconspicuous, there were some naturally occurring wetland areas in the southern portion of the study area, the main piece being outside of the lots being surveyed and not subject to future development. There was one notable very small wetland area just offline to the larger wetland area which contained *Ludwigia peploides, Azolla pinnata, Juncus usitatus* and *Marsilea hirsuta.* The height of the vegetation is up to 0.6m with a native species projected foliage cover of 20%. The vegetation is inhibited by grazing animals and the presence of dominant pasture grasses such as Kikuyu.

This community although small in area (is considered to be a part of the EEC Sydney Freshwater Wetlands.

Photo 7 – Freshwater Wetland near the southern study area boundary

Grey Box Woodland

This vegetation community only occurs along the western boundary, immediately to the west of the largest water body. It occupies an area of approximately 0.47ha with a canopy comprising almost exclusively of *Eucalyptus moluccana* (Grey Box) with a height of 17-22m and canopy cover of 15-25%.

The native mid-storey has been removed although there was *Bursaria spinosa* (Native Blackthorn) noted in Quadrat 5 as comprising less than 5% coverage. The mid-storey was heavily impacted through the invasion of *Lycium ferocissimum* (African Boxthorn) which, where established, has coverage of approximately 25-40% of the mid-storey.

The ground layer of vegetation is moderate in density and has been impacted by grazing and a dirt pathway. Common native species include *Cynodon dactylon, Einadia nutans* and *Einadia polygonoides.* The exotic species coverage usually outweighs the native species coverage.

The Grey Box Woodland is a remnant of the EEC Cumberland Plain Woodland. This EEC is listed as critically endangered at both state and commonwealth levels under the TEC Act 1995 and the EPBC Act 1999

Photo 8 – Remnant Cumberland Plain Woodland adjacent to the western study area boundary

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

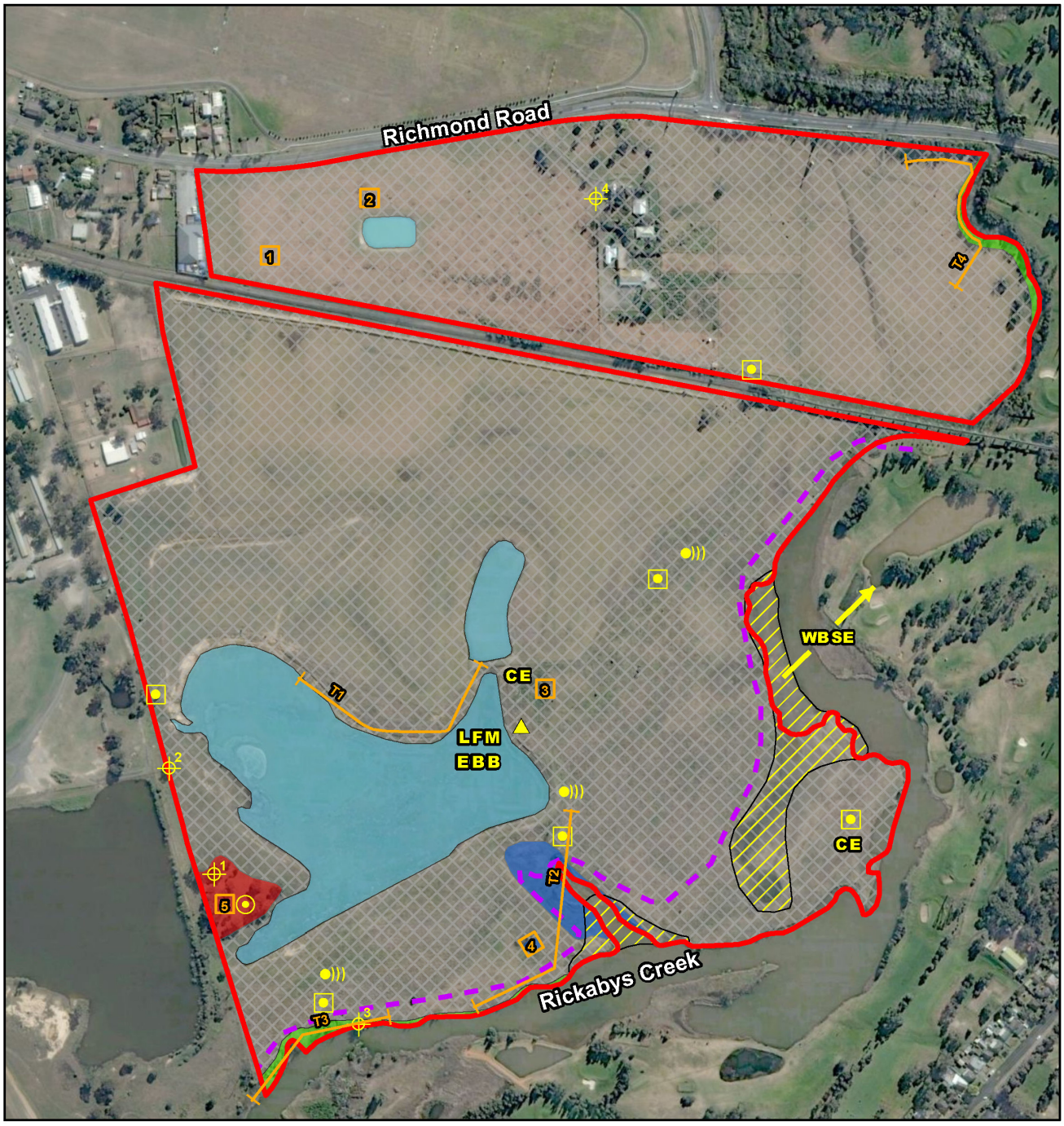
Common name	Scientific name	Method Observed
Birds		**July 2012**
Australasian Grebe	*Tachybaptus novaehollandiae*	O C
Australian Magpie	*Gymnorhina tibicen*	O
Australian Pelican	*Pelecanus conspicillatus*	O
Australian Wood Duck	*Chenonetta jubata*	O
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O
Black-fronted Dotterel	*Elseyornis melanops*	O
Black-shouldered Kite	*Elanus axillaris*	O
Black-winged Stilt	*Himantopus himantopus*	O
Black Swan	*Cygnus atratus*	O
Cattle Egret	*Ardea ibis*	O C
Chestnut Teal	*Anas castanea*	O
Collared Sparrowhawk	*Accipiter cirrhocephalus*	O [PR]
Common Myna *	*Acridotheres tristis*	O C
Common Starling *	*Sturnus vulgaris*	O C
Darter	*Anhinga melanogaster*	O C
Double-banded Plover	*Charadrius bicinctus*	O
Dusky Moorhen	*Gallinula tenebrosa*	O
Eurasian Coot	*Fulica atra*	O C
Galah	*Cacatua roseicapilla*	O
Grey Fantail	*Rhipidura fuliginosa*	O C
Grey Teal	*Anas gracilis*	O
Hardhead	*Aythya australis*	O
Hoary-headed Grebe	*Poliocephalus poliocephalus*	O [PR]
Little Black Cormorant	*Phalacrocorax sulcirostris*	O
Little Pied Cormorant	*Phalacrocorax melanoleucos*	O
Little Wattlebird	*Anthochaera chrysoptera*	C
Long-billed Corella	*Cacatua tenuirostris*	O C
Magpie-lark	*Grallina cyanoleuca*	O C
Masked Lapwing	*Vanellus miles*	O C
Noisy Miner	*Manorina melanocephala*	O C
Pacific Black Duck	*Anas superciliosa*	O C
Pied Currawong	*Strepera graculina*	C
Purple Swamphen	*Porphyrio porphyrio*	O
Rainbow Lorikeet	*Trichoglossus haematodus*	O C
Red-browed Finch	*Neochmia temporalis*	O C
Red-kneed Dotterel	*Erythrogonys cinctus*	O
Red-rumped Parrot	*Psephotus haematonotus*	O C
Restless Flycatcher	*Myiagra inquieta*	O C
Royal Spoonbill	*Platalea regia*	O
Spotted Turtle-Dove *	*Streptopelia chinensis*	O C
Superb Fairy-wren	*Malurus cyaneus*	O C
Welcome Swallow	*Hirundo neoxena*	O
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	O
White-faced Heron	*Egretta novaehollandiae*	O C
White-plumed Honeyeater	*Lichenostomus penicillatus*	O C
Willie Wagtail	*Rhipidura leucophrys*	O C
Yellow-billed Spoonbill	*Platalea flavipes*	O
Mammals		
Black Rat *	*Rattus rattus*	I

Common name	Scientific name	Method Observed
Brown Hare *	*Lepus lepus*	S
Domesticated Cattle *	*Bos taurus*	S
Eastern Bentwing-bat [TS]	*Miniopterus orianae oceansis*	A
European Red Fox *	*Vulpes vulpes*	S
Gould's Wattled Bat	*Chalinolobus gouldii*	A
Horse *	*Equus caballus*	O S
Large-footed Myotis [TS]	*Myotis macropus*	A
Rabbit *	*Oryctolagus cuniculus*	S
Reptiles		
Grass Skink	*Lampropholis guichenoti*	H
Amphibians		
Common Eastern Froglet	*Crinia signifera*	C
Eastern Banjo Frog	*Limnodynastes dumerilii dumerilii*	C [PO]
Smooth Toadlet	*Uperoleia laevigata*	C

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
[PO] indicates species identified to a 'possible' level of certainty

A	-	Anabat II/SD-1	C	-	Call Identification
O	-	Observation	P	-	Call-playback Response
T	-	Trap (Elliott, cage, etc.)	H	-	Habitat Search
S	-	Spotlight	I	-	Scat, Track or Sign Identification



Legend

Site Boundary
Edge of SREP 20 Wetland

Flora Survey Effort (2012)
Flora Quadrat (20x20m)
Flora Transect

Vegetation Communities
Cleared and Managed Pasture
Constructed Dams
Freshwater Wetlands (EEC)
Riparian Open Woodland (EEC)
Grey Box Woodland (EEC)

Fauna Survey Effort (2012)
Anabat Station
Nocturnal Call-playback Station
Habitat Tree
Diurnal Bird Census Point
Spotting Scope Outlook Station

Fauna Survey Results (2012)
CE Cattle Egret
WBSE White-bellied Sea Eagle (Flight Direction)
LFM Large-footed Myotis
EBB Eastern Bentwing-bat
Shoreline habitat area for wading birds

0 50 100 150 200 m

Travers bushfire & ecology
www.traversecology.com.au

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

PROJECT	REFERENCE
Clarendon	A12076

SCALE	DATE (ISSUE)	TITLE
1:6,000 @ A4	15/08/12	Figure 1 - Flora & Fauna Survey Effort & Results

Figure 1 - Flora and Fauna Survey Effort, Results and Identified Constraints

Ecological Assessment 4

4.1 Previous surveys reviewed

The *Vegetation Mapping of the Cumberland Plain (NPWS 2002)* – identified the north-eastern section of the riparian vegetation as map unit 12 - Alluvial Forest, equivalent to the EEC River-flat Eucalypt Forest on Coastal Floodplains. The patch of vegetation identified by *Travers bushfire & ecology* as Grey Box Woodland (Cumberland Plain Woodland) was identified by NPWS as map unit 10 - Shale Plains Woodland (Cumberland Plain Woodland).

Sydney Regional Environment Plan (SREP 20) – Hawkesbury Nepean identifies the low lying areas of Rickabys Creek as a mapped wetland (Wetland 145). This wetland starts at the Blacktown – Richmond Railway and heads south along the creek line for more than 2km.

4.2 Flora

No threatened flora species were observed. Landscaping species in close proximity to the dwellings and sheds were not necessarily identified and listed.

All species are listed in Table 3.1.

4.2.1 Local / regional flora matters

No ROTAP species were identified during the survey.

The following observed species however have some regional significance within the Hawkesbury LGA (UBBS, 1997):

- *Azolla pinnata*
- *Baumea acuta*
- *Bulbine bulbosa*
- *Einadia nutans* subsp. *linifolia*
- *Marsilea hirsuta*
- *Oxalis exilis*
- *Oxalis perennans*
- *Urtica incise*
- *Wahlenbergia stricta*

These species do not offer any particular constraint to development but would be considered to be uncommon in the Hawkesbury LGA.

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2012) database 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 study area provides varying levels of potential habitat for the following state listed threatened flora species:

- *Pimelea spicata*

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

No state listed threatened flora species were observed during survey(s) undertaken.

(b) Endangered flora populations (NSW)

There is one (1) known endangered population within Hawkesbury LGA, *Keraudrenia corollata.* This species occurs mostly within River-flat Eucalypt Forest, well to the north or north-west of the study area such as in the Colo area. Given the separation from the known population this endangered population is not likely to have suitable habitat within the study area.

Keraudrenia corollata is not represented within the study area.

(c) Endangered ecological communities (NSW)

Three (3) endangered ecological communities (EECs), Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands, were observed within the study area.

4.2.3 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 habitat presence and potential to occur within Appendix 2.1.

Based on the habitat assessment within Appendix 2.1, it is considered that the study area provides varying levels of potential habitat for the following nationally listed threatened flora species:

- *Pimelea spicata*

Pimelea spicata was not recorded within the study area.

(b) Endangered ecological communities (national)

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

This EEC is critically endangered at a national level. It occurs over an estimated area of 0.47ha adjacent to the western site boundary. It does not have any direct connectivity to any other bushland remnant, with a separation of 150m to remnant trees of either River-flat Eucalypt Forest or Cumberland Plain Woodland to the north, and 150m to River-flat Eucalypt Forest to the south. Although the remnant of vegetation is under 0.5ha, it may be considered a local extinction of the EEC.

4.2.4 Flora and EEC constraints assessment conclusions

There are EEC constraints present along Rickabys Creek and on the western study area boundary. The amount of vegetation present considered to comprise EEC vegetation makes up only 1.7-1.8ha of the entire site (approximately 75ha).

Given the critically endangered status of Cumberland Plain Woodland at a state and national level, it is generally advisable to retain and restore the vegetation insitu rather than look at options for future development. Offset proposals however may be considered in accordance with the *Principles of Use of Biodiversity Offsets in NSW* (NSW Office of the Environment).

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 4.1.

Table 4.1 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate	Steep	Drop-offs
Vegetation structure				
Closed Forest	Open Forest	Woodland ✓	Heath	Grassland ✓
Disturbance History				
Fire	Underscrubbing ✓	Cut & fill works ✓		
Tree clearing ✓	Grazing ✓			
Soil Landscape				
DEPTH:	Deep ✓	Moderate	Shallow	Skeletal
TYPE:	Clay ✓	Loam ✓	Sand ✓	Organic
VALUE:	Foraging ✓	Denning	Nesting ✓	Digging
WATER RETENTION:	Well Drained ✓	Damp / Moist ✓	Water logged ✓	Swamp / Soak ✓
Rock Habitat				
CAVES:	Large	Small	Deep	Shallow
CREVACES:	Large	Small	Deep	Shallow
ESCARPMENTS:	Winter / late sunny aspects		Shaded winter / late aspects	
OUTCROPS:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides	
SCATTERED/ISOLATED:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides	
Feed Resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias ✓	Melaleucas ✓	
	Banksias	Acacias		
SEEDING TREES:	Allocasuarinas	Conifers		

WINTER FLOWERING EUCALYPTS:	C. maculata	E. crebra	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta	E. tereticornis ✓	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn	Winter ✓	Spring ✓	Summer ✓
OTHER:	Mistletoe	Figs / Fruit	Sap / Manna	Termites
Foliage Protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate	Sparse ✓	
PLANT / SHRUB LAYER:	Dense	Moderate	Sparse ✓	
GROUNDCOVERS:	Dense	Moderate ✓	Sparse ✓	
Hollows / Logs				
TREE HOLLOWS:	Large	Medium	Small ✓	
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	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)	Bridge ✓	
FORREIGN 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 4.2 below provides hollow-bearing tree data and other habitat features recorded. Figure 1 provides locations of habitat trees.

Table 4.2 – Habitat tree data

Tree No	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	Hollows & Other Habitat Features Recorded
HT1	*E moluccana*	Grey Box	65	13	19	Large nest (Spoonbill?)
HT2	*stag*	stag	100	9	24	Large nest (Spoonbill?) 2x 0-5cm branch
HT3	*M styphelioides*	Prickly-leaved Tea Tree	50/30/50/ 60	12	15	2x 0-5cm branch 2x 5-10cm trunk 2x 0-5cm branch
HT4	-	Dead Stag	50	2	8	1x 20cm broken trunk

4.3.3 Local fauna matters

The White-bellied Sea Eagle and Restless Flycatcher are species recorded during surveys and are identified by the Urban Bushland Biodiversity Survey (NPWS 1997) as being regionally significant species.

There was no White-bellied Sea-Eagle nesting site recorded within the study area or observed nearby. It is expected that this species will forage over Rickabys Creek and also the large dams present. This species will continue to utilise these water bodies provided that sufficient development setbacks are provided. The planting of trees along the foreshores, that will in time provide hunting perches and screened buffers to development, will be more beneficial than distance setbacks alone. Planted buffers may reduce the acceptable setback distance for protection of sensitive fauna habitat.

The Restless Flycatcher was recorded foraging between the homestead and the railway line. Given that the survey was undertaken at the commencement of the breeding period for this mostly sedentary species, it is quite possible nesting activity is taking place within the study area. A nesting location was not investigated at the time of survey.

The Restless Flycatcher is not protected under threatened species legislation and therefore would not offer a constraint to development. The White-bellied Sea Eagle is a protected migratory species under the *EPBC Act 1999*. Given that a nest location was not recorded within or near to the study area this species is not likely to constrain development. However setbacks recommended for migratory and threatened wading birds would also be sufficient for the White-bellied Sea-Eagle.

4.3.4 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2012) database provided a list of threatened fauna species previously recorded within a 10km radius of the study area. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the study area.

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

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

COMMON NAME	TSC Act	Potential to occur
Blue-billed Duck	V	low
Freckled Duck	V	low
Black-necked Stork	E	low
Australasian Bittern	E	low
Black Bittern	V	low
Spotted Harrier	V	low
Little Eagle	V	low
Square-tailed Kite	V	low
Bush Stone-curlew	E	low
Comb-crested Jacana	V	low
Australian Painted Snipe	E	low

COMMON NAME	TSC Act	Potential to occur
Curlew Sandpiper	E	✓
Black-tailed Godwit	V	low
Little Lorikeet	V	low
Swift Parrot	E	low
Barking Owl	V	✓
Masked Owl	V	unlikely
Painted Honeyeater	V	low
Black-chinned Honeyeater	V	low
Regent Honeyeater	E4A	unlikely
Varied Sittella	V	low
Scarlet Robin	V	low
Flame Robin	V	low
Koala	V	low
Grey-headed Flying-fox	V	✓
East-coast Freetail Bat	V	✓
Eastern Falsistrelle	V	unlikely
Eastern Bentwing-bat	V	recorded
Large-footed Myotis	V	recorded
Greater Broad-nosed Bat	V	low
Macquarie Perch	V	✓

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

Two (2) state listed threatened fauna species, Eastern Bentwing-bat (*Miniopterus orianae oceansis*) and Large-footed Myotis (*Myotis macropus*), were recorded within the study area during surveys.

Large-footed Myotis *(Myotis macropus)*

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 in buildings (Richards 1995). The Large-footed Myotis predominantly forages along creeklines and over water bodies 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 Large-footed Myotis was recorded foraging over the large dam at regular hourly intervals between 8pm on 26 July 2012 until 5:30am the following morning. This activity would be expected to increase over warmer months. The large dam is considered high quality foraging habitat for this species and is likely utilised in association to Rickabys Creek and other surrounding large water bodies.

Other large foraging open water areas do occur just outside of the study area (including Rickabys Creek); however the high quality and amount of foraging area associated with the large dam, as well as the recorded continued use over-night during winter, would suggest that this dam is an important foraging resource and is a constraint to development in respect to this species.

As this species can be hollow-dependent, habitat trees HT2 & HT3 may be suitable for utilisation. Any removal of these trees would require replacement with nest boxes. If the species is found utilising the hollow during tree removal it would instead be preferred to relocate this hollow into another similar tree. Given these tree locations however, it would be expected that they would not be impacted by a development area.

It should be noted also that the large railway bridge that cuts through the study area may be suitable for roosting by this species and should be investigated during any further surveys

Eastern Bentwing-bat *(Miniopterus orianae oceanensis)*

The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small flying insects, predominantly moths (Dwyer 1995). The Eastern Bentwing-bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (Dwyer 1995). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995). Roost sites in tree hollows have not been reported within the literature reviewed.

This species has not been identified as utilising culverts for maternity roosts. Maternity roosts rather are occupied by up to 100,000 females with only (twelve) 12 maternity roosts known throughout the complete range (Hoy & Hall 2008).

The Eastern Bentwing-bat was recorded foraging over the large dam during overnight Anabat surveys on 26 July 2012. This species does not utilise tree hollows for roosting. The species would utilise all of the airspace within the subject site for foraging with concentrated activity over water bodies. As with the Large-footed Myotis, the railway bridge through the site may be utilised for roosting, however the Eastern Bentwing-bat would not utilise this structure for breeding. The Eastern Bentwing-bat is unlikely to offer a constraint to development within the study area given that foraging habitat is not likely unique and that potential roosting habitat will not be impacted.

FM Act – A review of the *EPBC Act Protected Matters Report* identified the presence of two (2) threatened aquatic species or habitat for these species within a 10km radius of the study area. These species are also listed under the *FM Act* and include the Macquarie Perch (*Macquaria austalasica*) and Australian Greyling (*Prototroctes maraena*). Although no threatened fish species have been previously recorded within the Rickabys Creek catchment, It is considered that this creek (that runs along the eastern and southern extent of the study area) provides potential habitat for the Macquarie Perch.

Threatened fish species will not offer a constraint to development provided that there will be no detrimental effect on water quality, water quantity, direct impacts upon riparian habitat or any obstructions to fish passage.

The proposed activity is not located in an area identified as critical habitat under the *FM Act*.

(b) Endangered populations (NSW)

There are no endangered fauna populations within the Hawkesbury LGA.

(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 study area is required to be considered under SEPP 44 as it falls within the Hawkesbury LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the study area 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.

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 found within the study area. These trees comprised less than 15% of the total number of trees within any vegetation community present and therefore the study area is not classified under SEPP 44 as 'potential Koala habitat'.

4.3.5 National environmental significance - fauna

(a) Threatened 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 study area. These species have been listed in Table A2.2 (Appendix 2), and those with potential habitat within the study area are required to be considered under a 7 part test.

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

Table 4.4 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	EPBC Act	Potential to occur
Australasian Bittern	E	low
Australian Painted Snipe	V	low
Swift Parrot	E	low
Regent Honeyeater	E	unlikely
Koala	V	low
Grey-headed Flying-fox	V	✓
Macquarie Perch	E	✓

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

(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 study area. These migratory species are considered in Table A2.3 (Appendix 2). Threatened migratory species are assessed in Table A2.2 (Appendix 2).

Of these species, the White-bellied Sea-Eagle was recorded in-flight over the study area during survey. This species is not nesting within the study area. It is however expected that the study area, particularly Rickabys Creek and the large dams, is utilised for foraging. Open water areas should be protected for this species and setbacks provided to permit their use. Restoration of waterside vegetation would provide an added benefit to this species such that the distance of an acceptable open area setback may be reduced.

The Cattle Egret was also recorded present during surveys however this species is unlikely to offer a constraint to development.

4.3.6 Fauna constraints assessment conclusions

The open land area of the subject site has been significantly modified for agriculture / grazing use and as a result this space has little threatened fauna species habitat value. In contrast to this the extensive open water habitats and associated shallows and floodplain fringes provide exceptional habitat for wading birds and waterfowl including migratory and threatened species. The recorded waterbird diversity during survey was particularly high and is expected to be utilised by other species on a seasonal basis.

The Curlew Sandpiper, endangered under state legislation, has been previously recorded within the study area. Several other threatened wading birds or waterfowl have been recorded utilising similar habitats in the nearby locality (out to 2km) many of which have not been recorded recently (in the last 8-10 years). These include Freckled Duck, Black-necked Stork, Australasian Bittern, Black Bittern and Australian Painted Snipe.

Furthermore, additional migratory birds listed under the JAMBA, CAMBA or ROKAMBA agreements, including Cattle Egret, Pacific Golden Plover, Sharp-tailed Sandpiper, Pectoral Sandpiper, Latham's Snipe, Little Curlew and Common Greenshank have been recorded to a reference point within the study area. The distance of accuracy provided with of these records suggest that they are not located at the reference point supplied and were likely obtained along the quality foreshore habitat areas of Rickabys Creek within the study area, which is most suitable for these species as compared to elsewhere in the immediate locality.

Further upstream and downstream of Rickabys Creek the riverbanks are steeper and the channel bed consistently narrower. The study area portion and side of Rickabys Creek alternatively has wide open mudflats. It appears that the large dam within the study area was previously a large wetland area associated with the open floodplain of Rickabys Creek and would have provided exceptional regional habitat for water birdlife.

The dam in its current state still holds value as an open water foraging resource for a number of waterbirds as well as the recorded nationally significant White-bellied Sea Eagle and threatened Large-footed Myotis. Whilst other threatened species may also utilise this resource, the steep edges due to damming has resulted in a lowering of foraging value around the fringes for waders. Use by waders should not be ruled out particularly given the large size and the proximate protected location to Rickabys Creek.

In addition to the open water habitat values within the study area, Figure 1 also shows important shoreline habitat areas for wading birds. Appropriate setbacks from open water and shoreline foraging areas would depend on proposed revegetation measures. A reduced setback would be appropriate where a restored vegetation fringe to these areas is proposed.

Hollow-dependent threatened microbat species were also recorded during survey. The loss of hollows potentially utilised for roosting and breeding is unlikely to cause a significant outcome based on remaining available foraging areas in the locality; however it should require a careful hollow removal process to ensure a local roosting colony, if present, may be relocated.

4.4 Potential ecological impact

The potential ecological impacts as a result of any proposed development on this site include:

- Loss or disturbance to foraging and nesting habitat for threatened, nationally significant and protected migratory birds under international agreements.
- Loss of remnant woodland that may be utilised for nesting by both wetland and woodland bird species.
- Loss of hollows particularly those of higher value located proximate to open water and woodland habitat features.
- Loss of native vegetation within the local area.
- Cumulative impacts of sedimentation and erosion into Rickabys Creek.
- Cumulative impacts of increased runoff from hard surfaces into Rickabys Creek.

4.5 Mitigation measures

Measures that may mitigate against ecological impacts mentioned above include:

- Provision of setbacks to open water and important shoreline areas. Important shoreline habitat is contained within flood-prone areas.
- Revegetation along the riparian fringes of Rickabys Creek. Replanting around the existing large dam.
- Provision of nest boxes or relocated hollows within woodland portions to replace any loss of hollows.
- Retention and restoration of the small patch of Cumberland Plain Woodland on the western boundary.
- Sediment and erosion control plan.
- Provision of a small buffer between the proposed development and SREP 20 wetlands.
- Retain the largest water body.
- Future landscape planting should incorporate the use of locally occurring species that are naturally found within Cumberland Plain Woodland or River-flat Eucalypt Forest communities.
- Setbacks to Rickabys Creek in line with the NSW Office of Water *Controlled Activity Guidelines 2012,* including no development within the SREP 20 area.

Conclusions & Recommendations 5

5.1 Recorded Threatened Species and Endangered Ecological communities

The document forms the basis of assessment required under Section 5A of the *EPA Act*. This assessment determines if future development of the site is likely to have a significant effect on threatened species, populations and / or EECs.

EPA Act and TSC Act

In respect of matters required to be considered under the *EPA Act* and relating to the species / provisions of the *TSC Act*.

- Two (2) threatened fauna species, Eastern Bentwing-bat (*Miniopterus orianae oceansis*) and Large-footed Myotis (*Myotis macropus*), were recorded within the study area.
- No threatened flora species were recorded within the study area
- Three (3) EECs, Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands, were recorded within or in close proximity to the study area
- No endangered populations have been observed

An ecological assessment that assesses the potential impacts on the recorded and potential threatened species, endangered populations and endangered ecological communities will be required to accompany a development application.

EPBC Act

In respect of matters required to be considered under the *EPBC Act:*

- No threatened fauna species were recorded within or in close proximity to the study area.
- Two (2) protected migratory fauna species listed under the *EPBC Act,* Cattle Egret (*Ardea ibis*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*), were recorded within or in close proximity to the study area.
- No threatened flora species were recorded within the study area
- No endangered populations were observed within the study area.

- One (1) EEC listed under the *EPBC Act* (Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest) was recorded within the study area.

Subject to the nature and extent of a proposed development scheme, a referral under the EPBC Act (1999) may be required.

FM Act

In respect of matters relative to the *Fisheries Management Act 1994*, no threatened fish species have been previously recorded within the Rickabys Creek catchment. It is however considered that this creek (which runs along the eastern and southern extent of the study area) provides potential habitat for the Macquarie Perch. Threatened fish species will not offer a constraint to development provided that there will be no detrimental effect on water quality, water quantity, direct impacts upon riparian habitat or any obstructions to fish passage.

However any planning scheme or future development application is likely to have water quality implications and some form of direct impact within 40m of Rickabys Creek. Therefore subject to the nature and extent of a proposed development scheme, an application to the NSW Office of Water is likely to be required to determine any requirements under the Water Management Act (2000) and the Fisheries Management Act (1994).

5.2 Ecological constraints

The ecological constraints for this site pertain to the following ecological and mapped features:-

- Rickabys Creek is identified (in part) as Wetland 145 under the State regional Environmental Planning policy as a wetland.
- Important migratory and threatened species habitat mostly contained with the mapped Wetland 145.
- Endangered ecological communities also within and immediately adjoining the SREP 20 wetland area.

These constraints are discussed in more detail below. However it is recognised that these ecological constraints mostly lie within flood affected portions of the landscape and are unlikely in themselves to be a constraint to development due to flooding restrictions on the landscape.

However, future development applications will need to address these matters as part of reporting pertaining to ecological, stormwater management and planning matters for the site.

SREP 20 Hawkesbury Nepean River

The low lying areas of Rickabys Creek are a mapped as environmentally sensitive areas (wetlands) as a result of SREP 20 wetland mapping which has identified these areas as a Wetland 145. This wetland starts at the Blacktown – Richmond Railway and heads south along the creek line for more than 2km. It will provide a significant constraint to the lower lying lands within the study area. This area is also likely to be part of mapped flood zones.

The constraints that apply with a SREP 20 Wetland have multiple considerations such as:-

- The boundary of the wetland is a legislative trigger for preparation of an environmental impact statement for any perceived impacts on the wetland area

- A buffer of up to 100m may apply to the wetland boundary subject to slopes and other associated constraints
- The water quality of the receiving waters must be maintained or improved
- Surface and groundwater dependent ecosystems should not be adversely affected as a result of changes in surface or groundwater flows
- Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced
- Scenic quality is to be protected

There are up to twelve (12) SREP 20 policies that need to be addressed in accordance with stipulated strategies which make the river and the wetland of prime importance and it may lead to requirements to undertake appropriate restoration works to maintain or improve the quality of the riverine and wetland landscape.

Waterbird Habitat

The extensive open water habitats and associated shallows and floodplain fringes provide high quality open habitat for wading birds and waterfowl including migratory and threatened species. The recorded waterbird diversity during survey was particularly high and this habitat is expected to be utilised by other species on a seasonal basis.

In addition to the open water habitat values within the study area, Figure 1 identifies important shoreline / floodplain habitat areas for wading birds. Appropriate setbacks from open water and shoreline foraging areas would depend on proposed revegetation measures. A reduced setback would be appropriate where a restored vegetation fringe to these areas is proposed. The most important bird habitat areas identified on Figure 1 are confined within the SREP 20 Wetlands area (see below).

The Curlew Sandpiper, endangered under state legislation, has been previously recorded within the study area. Several other threatened wading birds or waterfowl have been recorded utilising similar habitats in the nearby locality (out to 2km) many of which have not been recorded recently (in the last 8-10 years). These include Freckled Duck, Black-necked Stork, Australasian Bittern, Black Bittern and Australian Painted Snipe.

Furthermore, additional migratory birds listed under the JAMBA, CAMBA or ROKAMBA agreements including Cattle Egret, Pacific Golden Plover, Sharp-tailed Sandpiper, Pectoral Sandpiper, Latham's Snipe, Little Curlew and Common Greenshank have been recorded to a reference point within the study area. The accuracy of these records suggest that the reference point is not accurate however the quality of habitat along the Rickabys Creek portion within the study area is most suitable for these species as compared to elsewhere in the immediate locality.

Whilst other threatened species may also utilise the dam resource, the steep edges resultant from damming has resulted in a lowering of foraging value around the fringes for smaller waders. Use by waders should not be ruled out particularly given the large size and the proximate protected location to Rickabys Creek.

Recorded threatened and protected fauna species

The open water habitats of Rickabys Creek and the large dam present also provide foraging habitat for the recorded nationally significant White-bellied Sea Eagle and threatened Large-footed Myotis. These two species are dependent on open water-bodies for the majority of their foraging diet and survival. The recorded nationally significant Cattle Egret and threatened Eastern Bentwing-bat will also utilise the open water habitats and their fringes,

however these species are unlikely to be highly dependent on the study area, based on the availability of extensive local habitat.

The Large-footed Myotis is also a hollow-dependent microbat species and therefore the loss of hollows close to open water habitat would be an issue for ecological assessment purposes.

Endangered Ecological Communities (EEC)

The EECs including *Cumberland Plain Woodland*, *River-flat Eucalypt Forest on Coastal Floodplains* and *Freshwater Wetlands* occur generally on the perimeter of the study area. Along Rickabys Creek there is some remnant vegetation, although it is mostly on the Golf Course side of the creek. It comprises almost exclusively of Swamp Oak trees in the north (Eucalypts would have been removed in the past) and a combination of Swamp Oaks, Eucalypts and shrub species to the south-west. This vegetation is commensurate with the EEC0 - River-flat Eucalypt Forest on Coastal Floodplains. It occupies a total area of approximately 0.57ha.

There is an area of Freshwater Wetlands EEC off Rickabys Creek along the southern site perimeter in association with a small inlet off the creek which appears to remain wet or damp for most of the year and an adjacent small patch of sedges in a damp swale approximately 1.05ha in size.

The Cumberland Plain Woodland EEC occurs on the western boundary of the study area and occupies an area of approximately 0.42ha in size.

The River-flat Eucalypt Forest and Freshwater Wetlands are on flood constrained lands and would be unlikely to be developed for that reason alone unless used as recreational or open space. Rickabys Creek would also need to be protected and managed in accordance with the NSW Office of Water *Controlled Activity Guidelines, 2012.*

The Cumberland Plain Woodland is on slightly higher ground and may be less flood affected, however, the existing dams restrict access to the existing vegetation. This area lends itself to being a restoration area for Cumberland Plain Woodland. Cumberland Plain Woodland is critically endangered and should be retained and restored where possible.

5.3 Conclusion

From this review, large portions of the cleared and managed pasture areas are ecologically unconstrained and suitable for development due to the lack of native vegetation, absence of habitat features, and absence of fringing habitat to water bodies. Development areas are more constrained by potential flooding and are unlikely to result in an impact on any of the observed ecologically sensitive areas.

There is a however a significant constraint to development on the lower lying lands due to the protection of wetlands covered under SREP 20 (Figure 1).

The large water body within the site provides a feeding resource for wading birds as well as a resource for microbat species such as the Large-footed Myotis. It is thus recommended that the largest water body is retained insitu without any significant change except for beautification or stormwater management purposes.

It is expected that the River-flat Eucalypt Forest and Freshwater Wetlands EECs are unlikely to be developable due to flooding constraints. The Cumberland Plain Woodland is also situated in an impractical place for development.

As there were no threatened species observed, there are no further threatened flora constraints.

Any development on this land would be expected to aim to provide sufficient setbacks from ecologically sensitive land and to involve a significant level of potential revegetation works to aim to improve the local landscape particularly adjoining the mapped SREP 20 wetlands.

Modest planting programs would result in significant ecological gains onsite for all three of the listed EECs and can be used as a viable argument for some form of development on site.

Setbacks to ecologically sensitive areas potentially include:

- Provision of setbacks to the SREP 20 Wetland, open water and important habitat in shoreline areas (mostly contained within flood-prone areas) and in accordance with the NSW Office of Water *Controlled Activity Guidelines 2012*.
- Setbacks to Rickabys Creek in line with the NSW Office of Water *Controlled Activity Guidelines 2012* including no development within the SREP 20 area
- Protection of Cumberland Plain Woodland on the western boundary.

It is expected that any landscape management of the floodplain areas would involve:

- Provision of a buffer between the proposed development and SREP 20 wetlands of up to 100m
- Revegetation along the riparian fringes of Rickabys Creek
- Replanting around the existing water bodies to enhance fringing habitat areas
- Future landscape planting should incorporate the use of locally occurring species that are naturally found within Cumberland Plain Woodland or River-flat Eucalypt Forest communities.

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Standard Survey Methodology

A1

The survey methods outlined within this Appendix are standard techniques employed by *Travers bushfire & ecology.* 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 standard methods outline 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 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.

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.

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 capensis*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for 5-minute periods with 5-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.

Stag-watching will be undertaken where suitable large hollows for owl nesting / roosting show signs of activity or are located within development areas. Stag-watching of nesting trees should be undertaken during the recognised nesting period for owls with potential to occur.

1.3 Arboreal mammals

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

Baiting and layout for Elliottt 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 A1.3.2 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.

Elliottt 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 possible wet weather is 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.

Where habitat is suitable, the presence 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 5-minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

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 1 ha.

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 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 camera surveillance, spotlighting and activity searches.

Arboreal and terrestrial Elliottt 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 Elliottt trap, cage trap, hair tube or pitfall trap locations have an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all Elliottt 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 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.

Where difficult to access, sensitive or extended trapping periods are undertaken, surveillance cameras can be used in terrestrial mammal surveys. The surveillance camera is mounted on a tree and directed towards a closed baited cage trap. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, etc.

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 recognised expert, Barbara Triggs for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using Anabat 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.

Anabat Mk 2 and SD-1 detectors are used in fixed passive monitoring positions and / or during active nocturnal monitoring. Active monitoring is used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification.

Bat call recordings are interpreted through Anabat V and Anabat CF Storage and Interface Module ZCAIM devices and analysed using Anabat 6 and Analook 3.3q computer software packages.

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 water's 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.

All threatened frog species 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.

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 the Cumberland Plain Land Snail (*Meridolum corneovirens*) when in proximity to previous *Atlas of NSW Wildlife* database records and particularly where its typical host vegetation community is 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 searches 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 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) - Are bird surveys 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 recorded calls through a 15 watt *Toa Faunatech* amplifier to evoke a response from 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 55 watt spotlight powered by a 12 volt rechargeable battery. 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. 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.

Elliottt trapping - using Elliottt type A (33x10x10 cm) and Type B (45x15x15 cm), 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 recognised expert, Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

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 18x18x 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 Anabat monitoring - involves leaving the bat recorder 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.

Active Anabat monitoring - is a method of active microbat recording during stag-watching or during complete nocturnal survey. Active monitoring involves an SD-1 recorder allied with a PDA 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 PDA screen, a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle Anabat 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 sourced 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.

Camera surveillance - is used to monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A *Reconyx Hyperfire* digital weatherproof camera is used with a passive infrared motion detector and a night-time infrared illuminator. 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.

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 (eg none, light drizzle, heavy drizzle, heavy rain)
- Recent rain events (where relevant)
- Wind strength eg calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns)
- Wind direction
- Moon (where relevant) (eg none, 1/4 moon, 1/2 moon, 3/4 moon, full moon)

Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 below provides an assessment of potential habitat within the study area for state and nationally listed threatened flora species recorded within 10km on the *Atlas of NSW Wildlife* database (OEH) or indicated to have potential habitat present within 10km on the *EPBC 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 (✓)**
					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 OEH 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 gordonii OEH EPBC	E1	E	Erect or spreading shrub 0.5-1.5m high growing in heath and dry sclerophyll forest on sandstone outcrops. Distribution limits N-Bilpin S-Faulconbridge.	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	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 (✓)
					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 OEH 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
Dillwynia tenuifolia OEH	V	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	x	-	-	x	x
Eucalyptus benthamii OEH	V	V	Blue gum to 40 m high. Wet forest on sandy alluvial soils. Distribution limits N-Yarramundi S-Bents Basin.	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	-	-	-	-
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
Micromyrtus minutiflora OEH EPBC	E1	V	Spreading shrub to 2m high. Grows in dry sclerophyll forest dominated by Scribbly gums and Ironbarks on Tertiary Alluviums. Distribution limits Western part of Cumberland Plain.	x	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 (✓)
					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	
Olearia cordata EPBC	V	V	Shrub to 2m high. Grows in dry sclerophyll forest and shrubland on Hawkesbury sandstone. Distribution limits N-Wollombi S-Wisemans Ferry.	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	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories and near the shale/sandstone ecotone. Distribution limits N-Glen Davis S-Hill Top.	x	x	-	-	x	x
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 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.	✓	limited	✓	✓	low	✓
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 (✓)
					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 pulchella 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	x	-	-	x	x
Rhizanthella slateri EPBC	V	E	Underground orchid that is poorly known. Grows in sclerophyll forests. Usually only seen if the soil is disturbed. Flowers in Oct – Nov.	x	x	-	-	x	x
Tetratheca glandulosa OEH EPBC	V	V	Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. Distribution limits N-Mangrove Mountain S-Port Jackson.	x	x	-	-	x	x

OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* database
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
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* database. Updated 1:100,000 database map sheet requests to OEH are undertaken every 3 months as recommended. 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.

Table A2.2 below provides an assessment of potential habitat within the study area for state and nationally listed threatened fauna species recorded within 10km on the *Atlas of NSW Wildlife* database (OEH) or indicated to have potential habitat present within 10km on the *EPBC 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 (✓)**
					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.	×	×	-	-	×	×
Giant Barred Frog *Mixophyes iteratus* EPBC	E	E	Terrestrial inhabitant of rainforest and open forests. Distribution Limit: N-Border Ranges National Park. S-Narooma.	×	×	-	-	×	×
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.	×	marginal	×	×	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 (✓)
					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 280-1000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. Distribution Limit: N-Hunter River S-Eden.	×	×	-	-	×	×
Broad-headed Snake *Hoplocephalus bungaroides* EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. Distribution Limit: N-Mudgee Park. S-Nowra.	×	×	-	-	×	×
Blue-billed Duck *Oxyura australis* OEH	V	-	A completely aquatic species occurring mainly throughout the Murray-Darling basin in cool to warm temperate deep permanent freshwater lakes, lagoons and swamps with extensive reed-beds. Distribution Limit: N-Tenterfield. S-Albury.	×	✓	×	×	low	✓
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.	×	✓	✓	×	low	✓

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 (✓)
					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	
Black-necked Stork *Ephippiorhynchus asiaticus* OEH	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. Distribution Limit: N-Tweed Heads. S-Nowra.	×	✓	✓	×	low	✓
Australasian Bittern *Botaurus poiciloptilus* OEH 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.	×	Marginal within site itself	✓	×	low	✓
Black Bittern *Ixobrychus flavicollis* OEH	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater & brackish streams & ponds, sheltered mudflats and oyster slats. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	✓	✓	×	low	✓
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.	×	✓	✓	×	low	✓

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
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.	×	✓	×	×	low	✓
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.	×	✓	✓	6 yrs	low	✓
Red Goshawk *Erythrotriorchis radiatus* EPBC	E	V	Inhabits tall open forests and woodlands. Breeds in tall trees adjacent to watercourses of wetlands. Distribution Limit: N-Border Ranges National Park. S-Foster.	×	×	-	-	×	×
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.	×	✓	×	×	low	✓
Comb-crested Jacana *Irediparra gallinacean* OEH	V	-	Floating vegetation of deep and permanent vegetation-choked tropical and warm temperate wetlands and dams. Occasionally feeds along muddy wetland margins. Distribution Limit: N-Tweed Heads. S-Ku-ring-gai Chase National Park.	×	✓	×	×	low	✓

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Australian Painted Snipe *Rostratula australis* OEH EPBC	E	V	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.	×	✓	✓	×	low	✓
Curlew Sandpiper *Callidris ferruginea* OEH	E	-	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.	previously	✓	✓	×	✓	✓
Black-tailed Godwit *Limosa limosa* OEH	V	-	Regular summer migrant that forages along tidal mudflats, estuaries, sandspits, shallow river margins, sewerage ponds, inland on large shallow fresh or brackish waters. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	✓	×	×	low	✓
Major Mitchell's Cockatoo *Cacatua leadbeateri* OEH	V	-	Commonly found within the arid interior of Australia within desert scrubs, open woodland, mallee, mulga, and callitris woodlands. Distribution Limit: N-Goodooga. 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 (✓)
					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 > 2000m on 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.	×	✓	×	✓	low	✓
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.	×	✓	×	×	low	✓
Superb Parrot *Polytelis swainsonii* OEH	V	V	Inhabits open woodland and riverine forests of inland NSW. Distribution Limit: N-Near Walgett. S-South of Deniliquin.	×	×	-	-	×	×

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 (✓)
					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	
Barking Owl *Ninox connivens* OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. Distribution Limits: N-Border Ranges National Park. S-Eden.	previously	✓	✓	×	✓	✓
Powerful Owl *Ninox strenua* OEH	V	-	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits: N-Border Ranges National Park. S-Eden.	×	×	-	-	×	×
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.	×	marginal	×	×	unlikely	✓
Brown Treecreeper *Climacteris picumnus victoriae* OEH	V	-	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. Distribution Limit:(Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.	×	×	-	-	×	×
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.	×	×	-	-	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
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.	×	×	-	-	×	×
Painted Honeyeater *Grantiella picta* OEH	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.	×	✓	✓	×	low	✓
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.	×	✓	×	×	low	✓
Regent Honeyeater *Xanthomyza Phrygia* OEH EPBC	E4A	E	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 (✓)
					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	
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	✓	✓	low	✓
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.	×	✓	×	×	low	✓
Flame Robin *Petroica phoenicea* OEH	V	-	Summer: forests, woodlands, scrubs, from sea-level to *c.* 1,800m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. Distribution Limit: N northern NSW tablelands. S-South of Eden.	×	✓	×	×	low	✓
Star Finch *Neochmla ruficauda* OEH	E4	E	Occurs mainly in tall rank streamside grass and rushes within warm temperate to tropical swamps and woodlands. Distribution Limit: N-Tweed Heads. S-Campbelltown(?).	×	×	-	-	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
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.	×	✓	✓	×	low	✓
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.	×	×	-	-	×	×
Yellow-bellied Glider *Petaurus australis* OEH	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	×	×	-	-	×	×
Squirrel Glider *Petaurus norfolcensis* OEH	V	-	Mixed aged stands of eucalypt forest and woodlands including gum barked & high nectar producing species and hollow bearing trees. Distribution Limit: N-Tweed Heads. 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 (✓)
					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	
Long-nosed Potoroo *Potorous tridactylus* EPBC	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. Distribution Limit: N-Mt Warning 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.	previously	✓	✓	✓	✓	✓
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.	×	✓	✓	✓	✓	✓

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
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 Nation Park. S-Wollongong.	×	×	-	-	×	×
Eastern Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit: N-Border Ranges National Park. S-Pambula.	×	✓	×	×	unlikely	✓
Eastern Bentwing-bat *Miniopterus orianae oceansis* OEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains & 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.	×	✓	×	×	low	✓

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 (✓)
					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, openforest 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.	×	Limited, isolated and poor quality	-	-	×	×
Macquarie Perch *Macquaria australasica* EPBC	V	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 (✓)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Australian Greyling *Prototroctes maraena* EPBC	Part 2, Section 19 – Protected Fish	V	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (eg weirs, waterfalls).	×	marginal	×	×	unlikely	×

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

Table A2.3 below provides an assessment of potential habitat within the study area for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Protected Matters Tool*. Nationally threatened migratory species are considered in Table A2.2 above.

Table A2.3 – Migratory fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT** ***Migratory Breeding***	**Suitable Habitat Present (✓)**	**Recorded on Site (✓)**	**COMMENTS**
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. Sedentary; dispersive.	✓	✓	An individual was recorded in flight over the study area during survey. Following this a search for a nesting location within the study area was undertaken with none found present. It is considered that the study area particularly Rickabys Creek and the large dams are utilised for foraging. Open water areas should be protected for this species and setbacks provided to permit their use. Restoration of waterside vegetation would provide an added benefit to this species such that the distance of an acceptable setback may be reduced.
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.	×	-	-
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.	×	-	-

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
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.	×	-	-
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.	✓	✓	An individual was recorded in flight over the south-eastern portion of the study area during survey. An individual was later observed in the central southern portions of the study area. There are limited nesting opportunity present for this species and foraging habitat is largely present due to host species such as horses and cattle. The removal of these host species would reduce the potential for this species to occur across the open developable land area. This would not cause a constraint to development given the availability of similar foraging habitat in the surrounding locality.

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
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.	✓	×	-