Travers

bushfire & ecology

Flora & fauna assessment

Bedding Facility Additions
Cessnock Correctional Facility,
Cessnock

October 2016
(REF: A16099F)

Flora & Fauna Assessment

Cessnock Correctional Facility
Cessnock

OCTOBER 2016

Report Authors:	Michael Sheather-Reid B. Nat. Res. (Hons.) - Senior Ecologist
	Lindsay Holmes B. Sc. - Botanist
	Corey Mead B. App. Sc. - Fauna Ecologist
Plans prepared:	Emma Buxton B. Sc.
	Kelly Tucker Dip. SIS
Checked by:	Michael Sheather-Reid - Senior Ecologist (General manager)
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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.

ABN 64 083 086 677
PO Box 7138
Kariong NSW 2250

38A The Avenue
Mt Penang Parklands
Central Coast Highway
Kariong NSW 2250

t: 02 4340 5331
e: info@traversecology.com.au
www.traversecology.com.au

Executive Summary

Travers bushfire & ecology (TBE) has been engaged to undertake a flora and fauna assessment for future housing facilities for inmates at Cessnock Correctional Centre.

Impact areas include the development of the buildings and associated APZs. These collectively will hereafter be referred to as the 'subject site'. Any other areas surveyed outside of the subject site in the broader area will be referred to as the 'study area'. The study area for fauna incorporates much of the nearby locality given additional survey and habitat assessment for Squirrel Glider.

Development proposal

There are three (3) proposed facilities including a:

- 320 Bed Modular Accommodation to be located on the west side of the newly constructed 240 bed unit where DET modular classrooms are currently stored.
- 280 Bed Modular Accommodation on the south east side of the site in the location of the existing residential cottages.
- 400 Bed Modular Accommodation (Rapid Build) on the south west side of the site near or over existing demountable buildings.

Proposed APZs are extending out from each accommodation building and form part of the assessed area impacts.

Recorded threatened flora, fauna & EECs

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

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995*, eight (8) threatened fauna species including Squirrel Glider (*Petaurus norfolcensis*), Grey-crowned Babbler (*Pomatostomus temporalis*), Grey-headed Flying-fox (*Pteropus poliocephalus*), East-coast Freetail Bat (*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*), Little Bentwing-bat (*Miniopterus australis*), Eastern Cave Bat (*Vespadelus troughtoni*) and Large-footed Myotis (*Myotis macropus*), one (1) threatened flora species, *Rutidosis heterogama* and one (1) EEC, Lower Hunter Spotted Gum Ironbark Forest were recorded or observed by *TBE* within the study area.

The Eastern Bentwing-bat was recorded only to a 'probable' level of certainty and the Large-footed Myotis was recorded only to a 'possible' level of certainty. Surveys by *Advitech* (2012

& 2016) also recorded bat calls consistent with Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). This is a total of ten (10) threatened fauna recorded within the study area indicating that the landscape contains important habitat for fauna species.

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

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, one (1) threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), one (1) protected migratory bird species Great Egret (*Ardea alba*), one (1) threatened flora species, *Rutidosis heterogama,* and no EECs listed under this Act were recorded within the study area.

The proposed development was not considered to have a significant impact on matters of national environmental significance. A referral to the Department of Environment under the EPBC Act is not required.

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

Ecological impacts

The direct, indirect and cumulative impacts of the proposal have been carefully considered in Section 5.3 of this report.

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

- Removal/modification of 6.8 ha of EEC, Lower Hunter Spotted Gum Ironbark Forest.
- APZ impacts of 0.53 ha of Spotted Gum Plantation for the 320 bed build.
- Possible loss of small dam near north-west corner of the 320 bed build.
- Loss of up to 41% of the *Rutidosis heterogama* population by the 400 bed build (~10% of the upper limit of 41% occurs in APZs and may be impacted by slashing).
- Minor changes to local runoff towards the large dam.
- Subsequent removal of threatened fauna species foraging habitat including mature winter flower resources.
- Removal of a few small hollows.

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into remnant bushland.
- Spill-over effects into surrounding bushland areas, particularly from lights but to a lesser extent from noise.
- Reduced cross-site movements by small bird species such as passerines.

- Concentrated stormwater runoff from solid surfaces and subsequent increased flows.
- Potential loss of connectivity subject to installation of ancillary services.

Recommendations have been outlined within Section 5.4 to minimise the identified potential ecological impacts, address threatening processes and to create a more positive ecological outcome for threatened species and their associated habitats.

A key outcome of the is assessment is the preparation of a vegetation management plan that includes revegetation of some 9.8ha of EEC revegetation works, another 12.3ha of enrichment planting works within existing Spotted Gum plantations and strategic p[planting of canopy trees. This will result in an effective increase the area of the EEC onsite and enrich the quality of Squirrel Glider habitat within existing revegetation areas and connectivity throughout the landscape. Soil translocation and restoration works are also to be undertaken for *Rutidosis heterogama.*

Conclusion

The 7 part test of significance has concluded that the proposed development of the subject site at Cessnock Correctional Centre, is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats.

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

It is concluded that the proposal would not have a significant impact upon matters of national environmental significance, and hence a referral in respect to the *Environment Protection and Biodiversity Conservation Act 1999* is not required.

List of abbreviations

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 April 2007)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from October 2009)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from April 2011)
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOE	Commonwealth Department of Environment
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act*
EPBC Act	*Environment Protection and Biodiversity Conservation Act*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act*
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 Primary Industries
OEH	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	*Planning for bushfire protection 2006*
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	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOE)
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*
VMP	vegetation management plan

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Introduction 1

Travers bushfire & ecology (TBE) has been engaged to undertake a flora and fauna assessment for several proposed buildings for future housing of inmates at Cessnock Correctional Centre. There are three (3) proposed building areas, housing 280 beds, 320 beds and 400 beds respectively (1,000 in total).

The northern development will have minimal impact on any ecological matters, however some adjacent vegetation may be required for asset protection zone (APZ) management. The south-east development will impact on remnant scattered trees within the managed landscape. The south-west development will impact on large remnant scattered tree vegetation and *Rutidosis heterogama* habitat.

Impact areas include the development of the buildings and associated APZs. These collectively will be referred to as the 'subject site'. Any other areas surveyed outside of the subject site in the broader area will be referred to as the 'study area'. The study area for fauna incorporates much of the nearby locality given additional survey considerations of habitat and connectivity for Squirrel Glider.

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

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

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act 1995 (TSC Act)

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

part test of significance. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.2.2 Fisheries Management Act 1994 (FM Act)

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

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

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

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

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

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

A threshold criterion apply to specific NES matters which may determine whether a referral is or is not required, such as for the EPBC listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with DOE 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 Cessnock Correctional Centre proposes to upgrade the current facilities. This will include the refurbishment of some existing facilities as well as new development within the surrounding site requiring the removal of existing vegetation. Varying levels of vegetation/ Habitat removal will be required for the following three specific development areas:

- 320 Bed Modular Accommodation to be located on the west side of the newly constructed 240 bed unit where DET modular classrooms are currently stored.
- 280 Bed Modular Accommodation on the south east side of the site in the location of the existing residential cottages.
- 400 Bed Modular Accommodation on the south west side of the site near or over existing demountable buildings.

These areas specifically will therefore form the subject site for assessment. Proposed APZs are also extending out from each accommodation building and will also form part of the calculated area impacts.

Figure 1a shows the proposed development layout for initial plans for two of the development areas (320 and 280 bed security zones) and Figure 1b shows a later proposal for the third area (400 bed security zone).

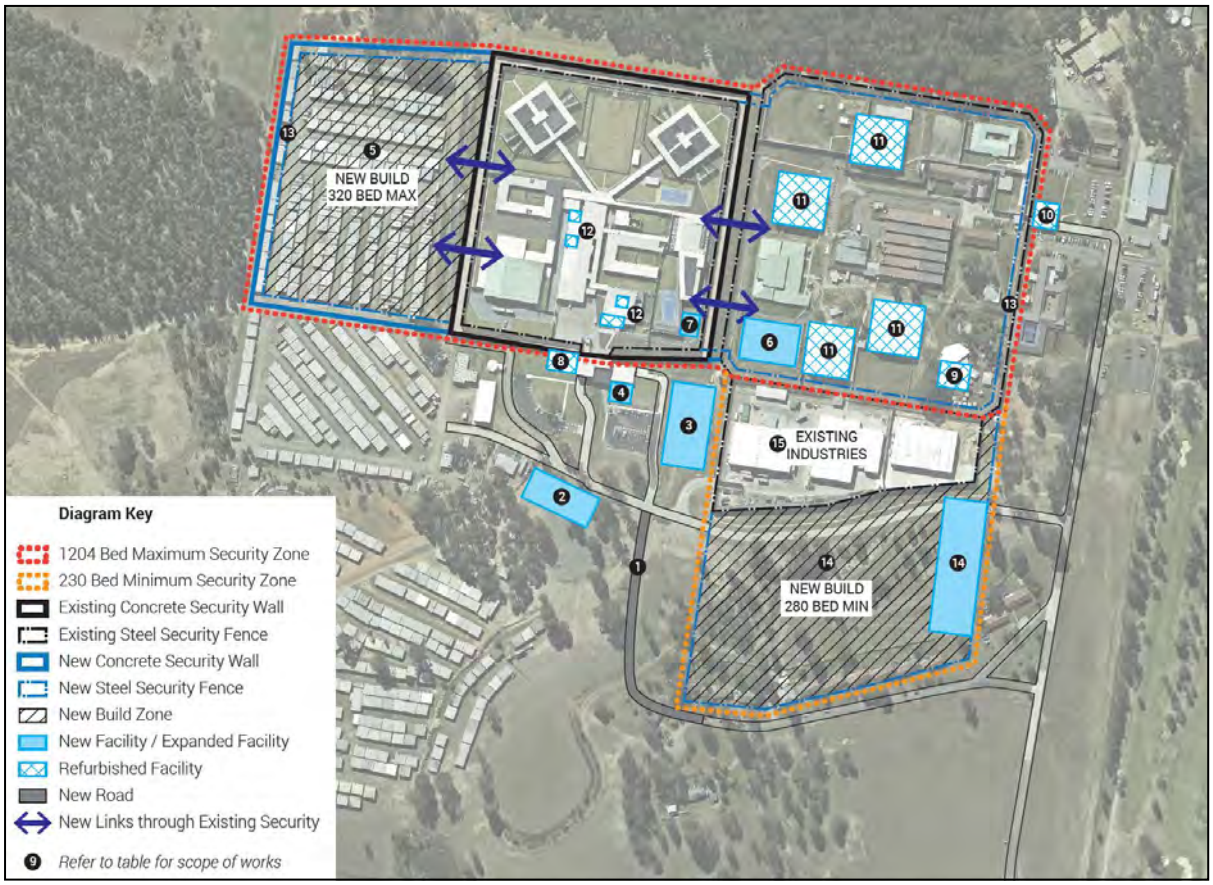

Figure 1a – Proposed 320 and 280 bed security zones

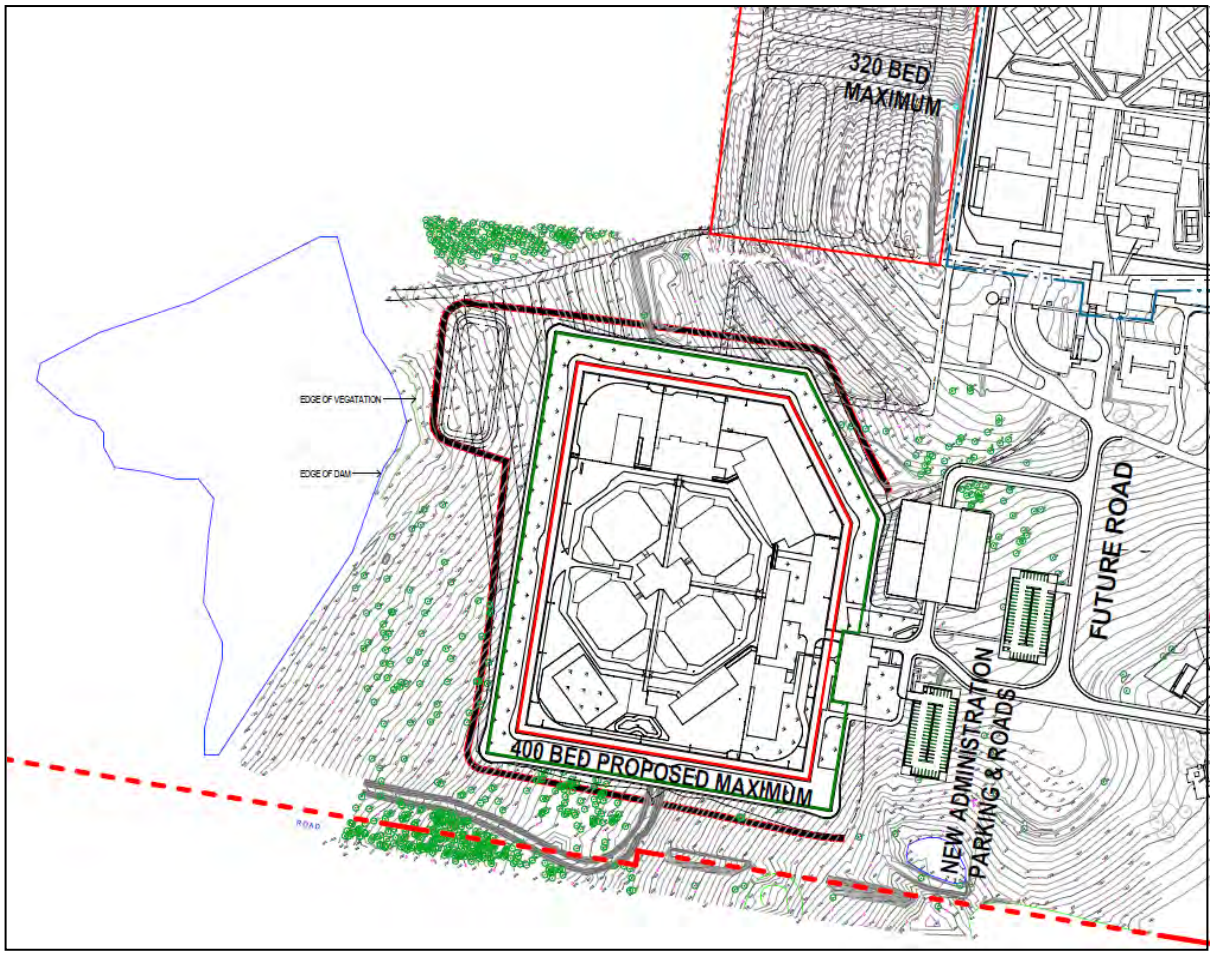

Figure 1b – Proposed 400 bed security zones

1.4 Site description

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

Table 1.1 – Site features

Location	75 Lindsay Street, Cessnock
Local government area	Cessnock
Grid reference	344000E 6367500N
Elevation	75-110m approx. AHD
Topography	Situated on a lightly sloping site, mostly 0-5 degrees. The highest elevations are situated in the south-western part of the study area
Geology	Geology; Permian Geology of the Dalwood Group, Farley Formation – Sandstone, mudstone, siltstone and shale erratics.
Catchment and drainage	There are two (2) creek lines which pass through or adjacent to the study area. Oaky Creek on the western side (including the large dam) and a tributary of Black Creek near the southern boundary.
Vegetation	Where present, native vegetation is part of bushland or remnant trees forming the endangered ecological community, Lower Hunter Spotted Gum Ironbark Forest.
Existing land use	Correctional facility with remnant woodland and vacant lands which are in part, managed.
Clearing	Approximately 10% of vegetation within the full extent of the Cessnock Correctional Facility lands contain good quality remnant bushland. There are remnant scattered trees in several locations and planted vegetation northeast and southwest of the large dam.

Survey Methodology 2

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

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

Client documents reviewed include:

- Site plans prepared by *NBRS Architecture* (2016)

Standard technical resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- Aerial photographs (Google Earth Pro / Spatial Information Exchange / NearMap)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act 1995* (TSC Act)
- *Fisheries Management Act 1994* (FM Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Rare or Threatened Australian Plants (ROTAP)
- Vegetation mapping from SIX Maps vegetation channel

Desktop assessment:

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

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

- ***A data search*** – A search of the *Atlas of NSW Wildlife* (OEH 2016) 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 DOE – 'protected matters search tool' website to generate a report that will help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in the area of interest. The search was broadened to a 10km radius like the Atlas search. These two searches combined, enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

Accuracy of identification:

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

***Licences*:**

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

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

2.2 Flora survey methodology

Flora survey has been undertaken on 5 dates. Initial survey included a random meander in accordance with Cropper (1993) to create a broad species list inventory (Table 3.1). During the random meander, some target threatened species searches are conducted, but additional searches are typically done after the quantitative survey.

Quantitative survey includes the placement of transect plots (quadrats) within vegetated parts of the site being investigated to assist in determining the vegetation type against known sources and benchmark criteria. A total of eleven (11) quadrats were undertaken during the site visits, with data collected in the same manner as collecting for BioBanking plot transects.

One (1) stand-alone transect was undertaken in the south-eastern development area.

Target searches for threatened species were limited to those with the most suitable habitat and were focussed on areas where the vegetation quality of good or where there was a relatively intact ground layer.

Once the threatened species *Rutidosis heterogama* was detected, further surveys were undertaken to ascertain the population size and extent. This included 1 full day survey by one person on the 16th August 2016, and 1 full day survey by two people on the 17th August 2016. All locations of this threatened species were recorded with a handheld *Trimble* GPS.

A review of the Atlas of NSW Wildlife, Bionet (OEH 2016) was undertaken prior to the botanical survey to identify threatened species previously recorded within 10km of the subject site and determine whether target searches were needed to be undertaken.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1. Previous survey by *Advitech* (2012 & 2016) has been incorporated also into this table. *Advitech* surveys in 2012 was focused on Lot 2 DP 76202 and in 2016 was focused on Lots 157 & 186 DP755252.

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 by *TBE* are provided in Section 2.6 and survey locations are depicted on Figure 2.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the study area. Previous survey by *Advitech* (2012 & 2016) has been incorporated also and indicated by a "*".

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	28/8/12 *	1/8 cloud, calm NNE wind, no rain, temp 20°C	Bird point survey	5hrs 1330 - 1730
	29/8/12 *	1/8 cloud, slight N wind, no rain, temp 24°C	Bird point survey	5hrs 1330 - 1730
	11/2/16 *	1/8 cloud, calm wind, no rain, temp 29°C	Diurnal opportunistic	3hrs 30min 0830 - 1200
	20/6/16	8/8 cloud, mod SE wind, no rain, temp 18°C	Diurnal census / opportunistic	2hrs 30min 1230 - 1500
		8/8 cloud, strong SE wind, moderate rain, temp 18°C	Diurnal opportunistic	2hrs 1500 - 1700
	27/7/16	0/8 cloud, mod SW wind, no rain, 16°C	Diurnal opportunistic	2hrs 1530 - 1730
	17/8/16	0/8 cloud, no wind, no rain, 22°C	Diurnal opportunistic	5hrs 1200 - 1730
Nocturnal birds	28/8/12 *	2/8 cloud, calm NNE wind, no rain, temp 17°C	Spotlighting & call playback	1hr 30min 1730 - 1900
	29/8/12 *	2/8 cloud, slight NE wind, no rain, temp 19°C	Spotlighting & call playback	1hr 30min 1730 - 1900
	20/6/16	7/8 cloud, strong NW wind, light rain, temp 15-14°C	Spotlighting & call identification	2hrs 1700 - 1900
			Call playback (Section 2.5 species)	Commenced @ 1730
	27/7/16	0/8 cloud, light-mod SW wind, no rain, late ¾ moon, 13°C	Spotlighting & call identification	1hr 30min 1730 - 1900
			Call playback (Section 2.5 species)	Commenced @ 1745
Arboreal mammals	28/8/12 *	2/8 cloud, calm NNE wind, no rain, temp 17°C	Spotlighting & call identification	1hr 30min 1730 - 1900
	29/8/12 *	2/8 cloud, slight NE wind, no rain, temp 19°C	Spotlighting & call identification	1hr 30min 1730 - 1900
	20/6/16	7/8 cloud, strong NW wind, light rain, temp 15-14°C	Spotlighting & call identification	2hrs 1700 - 1900
			Call playback (Section 2.5 species)	Commenced @ 1800
	27/7/16	0/8 cloud, light-mod SW wind, no rain, late ¾ moon, 13°C	Spotlighting & call identification	1hr 30min 1730 - 1900
			Call playback (Section 2.5 species)	Commenced @ 1800
	17/8/16	0/8 cloud, no wind, no rain, 22°C	Squirrel Glider habitat assessment	5hrs 1200 - 1730
	17/8/16	0/8 cloud, no wind, no rain, late 4/4 moon, 18-15°C	Spotlighting & call identification	1hr 30min 1730 - 1900
			Call playback (Squirrel Glider)	Commenced @ 1800
	18/8/16	0/8 cloud, no wind, no rain, 16-24°C	Squirrel Glider habitat assessment	3hrs 33min 0855 - 1230
Terrestrial mammals	28/8/12 *	2/8 cloud, calm NNE wind, no rain, temp 17°C	Spotlighting	1hr 30min 1730 - 1900
	29/8/12 *	2/8 cloud, slight NE wind, no rain, temp 19°C	Spotlighting	1hr 30min 1730 - 1900
	20/6/16	7/8 cloud, strong NW wind, light rain, temp 15-14°C	Spotlighting	2hrs 1700 - 1900
	27/7/16	0/8 cloud, light-mod SW wind, no rain, late ¾ moon, 13°C	Spotlighting	1hr 30min 1730 - 1900
	17/8/16	0/8 cloud, no wind, no rain, late 4/4 moon, 18-15°C	Spotlighting	1hr 30min 1730 - 1900

Bats	28/8/12 *	2/8 cloud, calm NNE wind, no rain, temp 17°C	Bat call detection	1hr 30min 1730 - 1900
	29/8/12 *	2/8 cloud, slight NE wind, no rain, temp 19°C	Bat call detection	1hr 30min 1730 - 1900
	20/6/16	7/8 cloud, strong NW wind, light rain, temp 15-14°C	Spotlighting	2hrs 1700 - 1900
			Anabat & SM4BAT (Passive monitoring) x2	Overnight from 1700
	26/7/16	0/8 cloud, no wind, no rain, temp 15-10°C	Anabat (Passive monitoring)	Overnight from 1700
	17/8/16	0/8 cloud, no wind, no rain, late 4/4 moon, 18-15°C	Spotlighting	1hr 30min 1730 - 1900
Reptiles	28/8/12 *	1/8 cloud, calm NNE wind, no rain, temp 20°C	Reptile survey	5hrs 1330 - 1730
	29/8/12 *	1/8 cloud, slight N wind, no rain, temp 24°C	Reptile survey	5hrs 1330 - 1730
	11/2/16 *	1/8 cloud, calm wind, no rain, temp 29°C	Indicated as herpetological survey	3hrs 30min 0830 - 1200
	20/6/16	8/8 cloud, mod SE wind, no rain, temp 18°C	Habitat search, opportunistic	2hrs 30min 1230 - 1500
	27/7/16	0/8 cloud, mod SW wind, no rain, 16°C	Habitat search, opportunistic	2hrs 1530 - 1730
Amphibians	28/8/12 *	2/8 cloud, calm NNE wind, no rain, temp 17°C	Spotlighting & call playback	1hr 30min 1730 - 1900
	29/8/12 *	2/8 cloud, slight NE wind, no rain, temp 19°C	Spotlighting & call playback	1hr 30min 1730 - 1900
	20/6/16	7/8 cloud, strong NW wind, light rain, temp 15-14°C	Spotlighting & call identification	2hrs 1700 - 1900
	27/7/16	0/8 cloud, light-mod SW wind, no rain, late ¾ moon, 13°C	Spotlighting & call identification	1hr 30min 1730 - 1900
	17/8/16	0/8 cloud, no wind, no rain, late 4/4 moon, 18-15°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	20/06/16, 07/07/16 and 26/07/16
Stratified sampling	20x20m and 50x20m quadrats in all existing bushland or remnant areas (BioBanking transect plot style) in close proximity to development areas. One (1) additional transect was undertaken at selected location where vegetation was sparse.	20/06/16, 07/07/16 and 26/07/16
Target searches	Target searches in known habitats	20/06/16, 26/07/16, 16/08/16 and 17/08/16

2.5 Site specific survey techniques

The following site specific survey measures were undertaken by TBE as part of our 2016 field visits. They do not describe the specific survey techniques applied by other consultants (*Advitech* 2012).

Diurnal birds

Six (6) diurnal bird census points were undertaken within the study area. A minimum of 20 minutes of survey was undertaken at each census point in an area radiating out to between 30-50m. Bird census points were selected to give an even spread and representation across the site and its communities (see Figure 2). Census points were also commenced in locations where bird activity was apparent, as often different small bird species are found foraging together. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

Allocasuarina were randomly searched for chewed cones indicating foraging activity by Glossy Black-Cockatoo.

Nocturnal birds

Given the suitability of habitat present Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*) were targeted by call-playback techniques.

Given that a nearby hollow-bearing tree (marked as HT2) provided Masked Owl roosting potential stag-watching was undertaken on the initial night of survey.

Arboreal and terrestrial mammals

Squirrel Glider

Given the suitability of habitat present Squirrel Glider (*Petaurus norfolcensis*) was initially targeted by call-playback techniques and spotlighting. At the time of initial field observations it appeared as though the south-west subject site (containing the proposed 400 bed security zone) represented the only observed location within the study area and nearby surrounds containing a high representation of mature Spotted Gum trees. Spotted Gum trees provide an important winter-spring foraging opportunity for nectarivores and large mature trees provide the most abundant yields.

Subsequent to this observation and adjacent records of Squirrel Glider within the reserve and golf course to the south, further target survey and habitat assessment was undertaken. The main objectives of this was to determine if Squirrel Glider family groups still persist in the locality and the comparable extent of Spotted Gums and other nectar foraging opportunities in the nearby local surrounds.

Survey incorporated spotlighting throughout the Correctional Centre lands (including the western portions not covered in initial survey) as well as the small reserve to the south and throughout the golf course (where previous records exist).

Further analysis of vegetation communities was undertaken for the remaining portions of the Correctional Centre grounds out to Oakey Creek Road as well as the local immediate surrounds. This included an analysis of vegetation along the margins of The Oaks Golf Club and within the bushland reserve to the south, within the connective lands to the north and along the verges of local roads where other gliding connectivity exists.

Within each area of vegetation notes were taken on the percentage representation of each constituent trees and their estimated average diameter at breast height (DBH) based on 10 selected trees of this species.

Locations providing a barrier to gliding opportunity were noted in order to map the potential local connectivity. As a guide the *Draft Squirrel Glider Planning & Management Guidelines* (LMCC 2015) indicates that the average gap crossing distance between trees for gliders is 1.8 times launch height minus 2 m. Furthermore, road gaps >35 m wide are considered a potential barrier to crossing.

Squirrel Glider habitat mapping (Figure 3) was prepared based on the data noted above specifically depicting:

- Previous Squirrel Glider recorded locations off *Bionet*
- Recorded locations of Squirrel Glider and denning hollows by *TBE*
- Suitable denning hollow location
- Gliding connectivity through the local landscape
- Isolated patches of habitat that gliders can only access by cross-the-ground movements
- A colour representation of available foraging tree locations and their respective sizes across the local landscape

Habitat trees

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

Additional hollows considered suitable for Squirrel Glider beyond the subject site were noted within the remaining Correctional Centre lands as well as the reserve and northern portions of the golf course to the adjacent south. This included identifying locations of suitable nest boxes for Squirrel Gliders.

A summary of hollow-bearing tree results is provided in Table 4.4. and locations are shown on Figure 2. All tree considered potentially suitable for Squirrel Glider within the site and adjacent lands nearby to the south are shown on Figure 3.

2.6 Survey limitations

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

Flora survey limitations

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

There has been extensive survey undertaken for *Rutidosis heterogama* in the western portion of the study area, however there is a gap in the data where specimens have not been surveyed but expected to occur at a similar density to the immediate surrounds (refer to figure 3). The survey has extended just beyond the southern boundary to identify if the population continues to the south, but has not been undertaken to the furthest extent. The original findings by the previous consultant near the northern boundary have not been reconfirmed, but the area approximately 50m to the west and beyond has been surveyed with no specimens confirmed.

Vegetation on the western side of the large dam has been briefly surveyed with a focus on searches for *Rutidosis heterogama.* The vegetation boundaries in this area have not had stratified surveys undertaken (plot transects), however the proposal will have no impact upon this area.

Fauna survey limitations

Recent initial survey by *TBE* in the proposed 320 and 280 bed security zone areas was during poor and cool winter conditions with low temperatures, high winds and intermittent rain showers. This stimulated calls by winter calling frogs but reduced the recording potential of microbat species. A second night of bat recording was undertaken during more suitable conditions but still within the low activity winter period. Previous survey by *Advidech* in late August 2012 and in February 2016 compensates for this deficiency and gives a separate seasonal representation of all fauna.

Recent survey by TBE was immediately prior to a predicted high winter flowering yield of Spotted Gum. Numerous trees were noted as going to bud simultaneously. Survey during the flowering period of these (particularly mature) trees would ideally give indication of their significance to winter blossom dependent migratory birds.

The size and percentage extent of potential nectar foraging trees for Squirrel Gliders on the Squirrel Glider habitat mapping on Figure 3 is indicative only based on field observations and notes taken on DBH and percent presence in different areas.

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 the Table 3.1 below.

Table 3.1 – Flora observations for the study area

Family	Scientific name	Common name
Trees		
Mimosaceae	*Acacia parvipinnula*	Silver-stemmed Wattle
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Myrtaceae	*Corymbia filicifolia**	Red-flowering Gum
Myrtaceae	*Corymbia maculata*	Spotted Gum
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus fibrosa*	Broad Leaved Ironbark
Myrtaceae	*Eucalyptus paniculata*	Grey Ironbark
Myrtaceae	*Eucalyptus punctata*	Grey Gum
Myrtaceae	*Eucalyptus siderophloia*	Northern Grey Ironbark
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany
Moraceae	*Ficus rubiginosa*	Port Jackson Fig
Proteaceae	*Grevillea robusta*	Silky Oak
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda
Myrtaceae	*Lophostemon confertus*	Brush Box
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Shrubs		
Mimosaceae	*Acacia elongata*	-
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia podalyriifolia*	Queensland Silver Wattle
Mimosaceae	*Acacia sp.*	
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Pittosporaceae	*Bursaria spinosa*	Blackthorn
Asteraceae	*Cassinia aculeata*	Dolly Bush
Faboideae	*Chorizema parviflorum*	Eastern Flame Pea
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea
Fabaceae	*Dillwynia retorta*	-
Sapindaceae	*Dodonaea viscosa* subsp. *cuneata*	Sticky Hop Bush
Santalaceae	*Exocarpos strictus*	Pale Ballart
Proteaceae	*Grevillea montana*	-
Proteaceae	*Hakea sericea*	Needlebush

Family	Scientific name	Common name
Fabaceae	*Hovea linearis*	-
Fabaceae	*Indigofera australis*	Native Indigo
Fabaceae	*Jacksonia scoparia*	Dogwood
Myrtaceae	*Leptospermum petersonii**	Lemon Scented Tea-tree
Epacridaceae	*Leucopogon juniperinus*	Prickly Beard-heath
Epacridaceae	*Lissanthe strigosa*	Peach Heath
Myrtaceae	*Melaleuca nodosa*	Ball Honey Myrtle
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive
Asteraceae	*Olearia sp.*	-
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Groundcovers		
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel
Poaceae	*Aristida vagans*	Three-awn Speargrass
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Asteraceae	*Brachycome aculeata*	-
Asteraceae	*Brachycome multifida*	Cut-leaved Daisy
Acanthaceae	*Brunoniella australis*	Blue Trumpet
Crassulaceae	*Bryophyllum delagoense**	Mother-of-Millions
Anthericaceae	*Caesia parviflora*	-
Sinopteridaceae	*Cheilanthes sieberi*	Rock Fern
Poaceae	*Chloris gayana**	Rhodes Grass
Asteraceae	*Conyza sumatrensis**	Fleabane
Poaceae	*Cortaderia selloana**	Pampas Grass
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus brevifolius**	Mullumbimby Couch
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax Lily
Phormiaceae	*Dianella revoluta*	Blueberry Lily
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass
Convolvulaceae	*Dichondra repens*	Kidney Weed
Iridaceae	*Dietes grandiflora**	Spanish Iris
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Chenopodiaceae	*Einadia nutans* subsp. *linifolia*	Climbing Saltbush
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Asteraceae	*Epaltes australis*	-
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Asteraceae	*Euchiton involucratus*	Star Cudweed
Asteraceae	*Euchiton sphaericus*	-
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-rush
Asteraceae	*Gamochaeta spicata**	Cudweed
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Dilleniaceae	*Hibbertia pedunculata*	-
Asteraceae	*Hypochaeris radicata**	Flatweed
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Juncaceae	*Juncus planifolius*	Broad Rush
Juncaceae	*Juncus usitatus*	Common Rush
Juncaceae	*Juncus sp.*	-

Family	Scientific name	Common name
Asteraceae	*Lagenophora stipitata*	-
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily
Brassicaceae	*Lepidium africanum**	Common Peppercress
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush
Solanaceae	*Lycopersicon esculentum**	Tomato
Cactaceae	*Opuntia stricta**	Prickly Pear
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel
Poaceae	*Panicum simile*	Two Colour Panic
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Paspalum quadrifarium**	Tussock Paspalum
Poaceae	*Paspalum urvillei**	Vasey Grass
Plantaginaceae	*Plantago lanceolata**	Ribwort
Rubiaceae	*Pomax umbellata*	Pomax
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Polygonaceae	*Rumex crispus**	Curled Dock
Asteraceae	***Rutidosis heterogama*** [TS]	**-**
Poaceae	*Rytidosperma fulvum*	Wallaby Grass
Cyperaceae	*Schoenus sp.*	-
Asteraceae	*Senecio madagascariensis**	Fireweed
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Solanaceae	*Solanum nigrum**	Black Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Caryophyllaceae	*Stellaria media**	Common Chickweed
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass
Asteraceae	*Taraxacum officinale**	Dandelion
Poaceae	*Themeda triandra* (syn. *T. australis*)	Kangaroo Grass
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily
Fabaceae	*Trifolium repens**	White Clover
Typhaceae	*Typha orientalis*	Cumbungi
Verbenaceae	*Verbena bonariensis**	Purpletop
Asteraceae	*Vernonia cinerea var. cinerea*	-
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell
Violaceae	*Viola hederacea*	Ivy-leaved Violet
Vines		
Convolvulaceae	*Convolvulus erubescens*	Australian Bindweed
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Glycine tabacina*	Variable Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
* denotes exotic species [TS] **denotes threatened species (bold text)**		

3.1.2 Vegetation communities

The following vegetation communities were identified within the subject site through ground truthing.

- Vegetation Community 1 – Lower Hunter Spotted Gum Ironbark Forest (EEC) with the following variants
    A. Moderate – Good, Fully Structured
    B. Managed Understorey and Thinned Canopy

C. Canopy Only with no Understorey

- Vegetation Community 2 – Dams with Fringing Vegetation
- Vegetation Community 3 – Swamp Oak Forest (EEC)
- Vegetation Community 4 – Spotted Gum Plantation

Vegetation Community 1 – Lower Hunter Spotted Gum Ironbark Forest (EEC)

This community occurs in a few different states, according to the type of previous or ongoing management. There is moderate-good quality fully structured vegetation in the northern portion of the study area and also along the south-western boundary adjoining residential development (partly within an unformed road corridor). There are other stands of remnant vegetation which has been thinned, but containing appropriate species mix to form the same community. The understorey however has been almost fully removed or management, however the ground layer may be partly intact. There is also one (1) stand of vegetation which contains trees only but has a bitumen or similar ground covering to stop ongoing regeneration.

Canopy – Eucalyptus fibrosa, Corymbia maculata and *Eucalyptus crebra* are the three (3) main constituent canopy species. The intact vegetation may have a projected foliage cover of 30-40%, however may be reduced to 15-25% to in the impacted remnants. The height of the vegetation ranges mostly between 15-25m tall.

Sub-canopy – Allocasuarina littoralis.

Mid-storey – Acacia parvipinnula, Dodonaea viscosa subsp. *cuneata, Bursaria spinosa, Daviesia ulicifolia, Acacia falcata, Persoonia linearis, Hakea sericea, Acacia elongata, Pittosporum undulatum, Breynia oblongifolia* and *Indigofera australis.* The height of this vegetation is usually 1-4m tall and with a projected foliage cover of 5-20%.

Photo 1 – Intact higher quality vegetation in the northern portion of the study area

Groundlayer – Non-grasses: *Cheilanthes sieberi, Lomandra longifolia, Lomandra multiflora, Vernonia cinerea, Goodenia hederacea, Pomax umbellata, Pratia purpurascens, Laxmannia gracilis, Lepidosperma laterale, Dianella revoluta, Brunoniella australis, Glycine clandestina, Solanum prinophyllum, Zornia dyctiocarpa, Phyllanthus hirtellus, Chorizema parviflorum,*

Brachyscome aculeata and *Lagenophora stipitata.* Grasses: *Entolasia stricta, Themeda triandra, Aristida vagans, Cymbopogon refractus* and *Echinopogon caespitosus* var. *caespitosus.* Intact vegetation has a ground layer coverage of approximately 40-70%.

Photo 2 – Regrowth vegetation (quadrat 3)

Photo 3 – Managed understorey vegetation near quadrat 10 and where there is Rutidosis heterogama

Photo 4 – Remnant trees, possibly thinned but with a ground layer dominated by native grasses with some herbs (quadrat 7)

Photo 5 – Remnant trees with a bitumen ground layer stopping natural regeneration

Vegetation Community 2 - Dams with Fringing Vegetation

No dams will be directly impacted by the proposal thus botanical survey has not been undertaken within them. The large dam to the west has fringing macrophytes such as *Typha orientalis* and whilst not surveyed, appears to be *Baumea* spp.

Photo 6 – Macrophytes growing in the shallows of the large dam

Vegetation Community 3 – Swamp Oak Forest (EEC)

No quadrats or transects have been taken in this community however target searches for relevant threatened species shave been undertaken on the eastern edge of the large dam given there may be indirect impacts.

The native species are restricted almost exclusively to the tree *Casuarina glauca* which is up to 20m tall and with a projected foliage cover of 40-75%.

Photo 7 – Swamp Oak trees that line the large dam

Vegetation Community 4 – Spotted Gum Plantation

Photo 8 – Planted vegetation with rare shrubs and regrowth ground layer

The plantation occurs in the north-western portion of the study area and to the south-west of the existing large dam. The canopy is derived from a Spotted Gum plantation (*Corymbia maculata*) although the very seldom Ironbark tree has regrown and may form a sub-canopy. The mid-storey may contain seldom specimens of *Acacia parvipinnula, Acacia falcata, Acacia elongata, Breynia oblongifolia* and *Hakea sericea.* The specimens comprise less than a 5% projected foliage cover for the mid-storey.

The ground layer has a moderate diversity containing generally the same species as listed for Vegetation Community 1. Other common species occurring include *Cynodon dactylon, Einadia nutans* subsp. *linifolia, Dichondra repens* and *Imperata cylindrica* var. *major.*

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		***Advitech*** **(Feb 2012 & 2016)**	***TBE*** **(June/Aug 2016)**
Australasian Grebe	*Tachybaptus novaehollandiae*	✓	
Australian Hobby	*Falco longipennis*		O
Australian King Parrot	*Alisterus scapularis*		O W
Australian Magpie	*Cracticus tibicen*	✓	O W
Australian Raven	*Corvus coronoides*	✓	O W
Australian White Ibis	*Threskiornis molucca*	✓	
Australian Wood Duck	*Chenonetta jubata*	✓	O
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	✓	O W
Black Swan	*Cygnus atratus*	✓	O W
Blue-faced Honeyeater	*Entomyzon cyanotis*		O W
Brown Goshawk	*Accipiter fasciatus*		O W
Clamorous Reed-Warbler	*Acrocephalus australis*		
Crested Pigeon	*Ocyphaps lophotes*	✓	O
Dusky Moorhen	*Gallinula tenebrosa*		O W
Eastern Rosella	*Platycercus eximius*	✓	O W
Eurasian Coot	*Fulica atra*	✓	O W
Galah	*Eolophus roseicapillus*	✓	O W
Golden Whistler	*Pachycephala pectoralis*		O
Great Egret	*Ardea alba*		O
Grey-crowned Babbler [TS]	***Pomatostomus temporalis***	✓	**O W**
Grey Fantail	*Rhipidura albiscapa*		O W
Grey Teal	*Anas gracilis*	✓	
Hoary-headed Grebe	*Poliocephalus poliocephalus*		O
Laughing Kookaburra	*Dacelo novaeguineae*	✓	O W
Little Black Cormorant	*Phalacrocorax sulcirostris*		O
Little Corella	*Cacatua sanguinea*	✓	O W
Little Pied Cormorant	*Microcarbo melanoleucos*		O
Magpie-lark	*Grallina cyanoleuca*	✓	O W
Masked Lapwing	*Vanellus miles*	✓	O W
Mistletoebird	*Dicaeum hirundinaceum*		O W
Musk Lorikeet	*Glossopsitta concinna*		O W
Nankeen Kestrel	*Falco cenchroides*		O
New Holland Honeyeater	*Phylidonyris novaehollandiae*		
Noisy Friarbird	*Philemon corniculatus*		O W
Noisy Miner	*Manorina melanocephala*	✓	O W
Pacific Black Duck	*Anas superciliosa*	✓	O W
Peregrine Falcon	*Falco peregrinus*	✓	
Pied Butcherbird	*Cracticus nigrogularis*	✓	O W
Pied Cormorant	*Phalacrocorax varius*	✓	
Purple Swamphen	*Porphyrio porphyrio*	✓	O W
Rainbow Lorikeet	*Trichoglossus haematodus*	✓	O W
Red-rumped Parrot	*Psephotus haematonotus*		O W
Rose Robin	*Petroica rosea*		O
Royal Spoonbill	*Platalea regia*		O
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*		O W
Silvereye	*Zosterops lateralis*		O W

Common name	Scientific name	Method observed	
Striped Honeyeater	*Plectorhyncha lanceolata*		O W
Spotted Pardalote	*Pardalotus punctatus*	✓	
Sulphur-crested Cockatoo	*Cacatua galerita*	✓	
Superb Fairy-wren	*Malurus cyaneus*	✓	
Weebill	*Smicrormis brevirostris*		O W
Welcome Swallow	*Hirundo neoxena*	✓	O W
White-faced Heron	*Egretta novaehollandiae*	✓	O
White-throated Gerygone	*Gerygone olivacea*	✓	
White-winged Chough	*Corcorax melanorhamphos*	✓	
Willie Wagtail	*Rhipidura leucophrys*	✓	O W
Yellow-faced Honeyeater	*Caligavis chrysops*		O W
Yellow Thornbill	*Acanthiza nana*		O W
Mammals			
Chocolate Wattled Bat	*Chalinolobus morio*		U[PO]
Common Brushtail Possum	*Trichosurus vulpecula*		O
Dog *	*Canis lupus familiaris*		O W
East-coast Freetail Bat [TS]	***Micronomus norfolkensis***	✓	**U**
Eastern Bentwing-bat [TS]	***Miniopterus orianae oceanensis***		**U[PR]**
Eastern Cave Bat [TS]	***Vespedelus troughtoni***		**U**
Eastern Falsistrelle [TS]	***Falsistrellus tasmaniensis***	✓	
Eastern Grey Kangaroo	*Macropus giganteus*	✓	O
European Red Fox *	*Vulpes vulpes*		O K
Gould's Wattled Bat	*Chalinolobus gouldii*	✓	U
Greater Broad-nosed Bat [TS]	***Scoteanax rueppellii***	✓	
Large-footed Myotis[TS]	***Myotis macropus***		**U[PO]**
Long-eared Bat	*Nyctophilus sp.*		U[PO]
Little Bentwing-bat [TS]	***Miniopterus australis***		**U**
Little Forest Bat	*Vespadelus vulturnus*		U[PR]
Rabbit *	*Oryctolagus cuniculus*	✓	O P
Squirrel Glider [TS]	***Petaurus norfolcensis***		**O**
Reptiles			
Delicate Skink	*Lampropholis delicata*	✓	
Grass Skink	*Lampropholis guichenoti*		O
Eastern Blue Tongue Lizard	*Tiliqua scincoides*		O
Amphibians			
Broad-palmed Frog	*Litoria latopalmata*	✓	
Brown Toadlet	*Pseudophryne bibronii*		W
Common Eastern Froglet	*Crinia signifera*	✓	W
Spotted Marsh Frog	*Limnodynastes tasmaniensis*		W
Striped Marsh Frog	*Limnodynastes peronii*		W
Whistling Tree Frog	*Litoria verreauxii*	✓	W

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

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

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

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

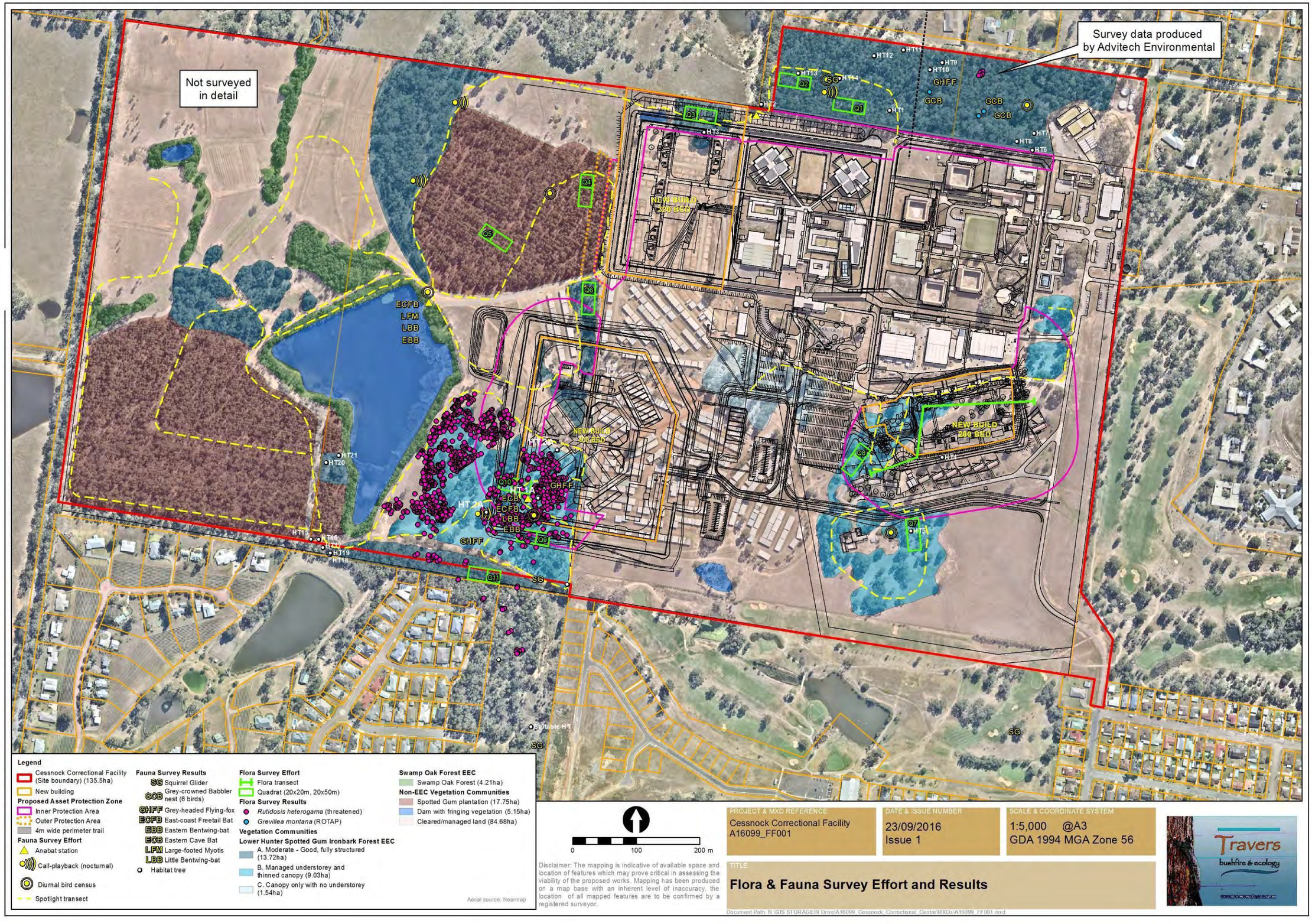

Figure 2 – Flora and fauna survey effort and results

Ecological Assessment 4

4.1 Previous surveys reviewed

The SIX maps vegetation channel was consulted to assist in identifying the vegetation which has been surveyed. In addition, there has been a recent assessment of the vegetation along the northern boundary of the site and our study area has overlapped.

The previous mapping of the site (broad-scale) has identified a few potential vegetation types, however an analysis of all quadrats in remnant bushland indicates that the vegetation is Lower Hunter Spotted Gum Ironbark Forest. There is also Swamp Oak Woodland around the larger dam, and a planted Spotted Gum Forest which has some understorey regrowth which would be expected within Lower Hunter Spotted Gum Ironbark Forest. The previous assessment has also identified the vegetation as Lower Hunter Spotted Gum Ironbark Forest.

Flora and Fauna Impact Assessment - Cessnock Correctional Centre (Advitech environmental 2012)

This report was prepared for a proposed demountable building storage area within Lot 2 and part of Lot 3 DP76202. The proposed works include the construction of a road network and associated earthworks and all to be located in the largely cleared area in the centre of the site.

One threatened flora species, *Rutidosis heterogama* (Heath Wrinklewort), was recorded within the Spotted Gum – Ironbark Woodland in the southern portion of the site. A random meander throughout this area recorded at least 230 plants and the number of plants on site is likely to be >500 as *R. heterogama* was a common component of the understorey in this area. One ROTAP listed species, *Grevillea montana* was also recorded within the Spotted Gum – Ironbark Forest community located in the northwest of the site. This area is well outside the proposed development footprint and the proposal is unlikely to impact upon this species.

Calls consistent with three species of hollow-roosting threatened microchiropteran bats were recorded within the site, being Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), East Coast Freetail Bat (*Mormopterus norfolkensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

In terms of the proposed impact of works, the Stage 2 development encompassed almost the entire extent of *Rutidosis heterogama* on site and an area of Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion EEC. As a result of these ecological constraints this area was identified for retention and did not form part of the proposal.

4.2 Flora

One (1) species of mistletoe was observed but not identified. A few landscaping species were also identified just north of existing houses however not all of those species were identified.

One (1) threatened flora species were observed, *Rutidosis heterogama.* There is a large population in the south-west corner of the study area amongst remnant vegetation which is managed. A few specimens were also noted in the north-east corner of the study area in a previous survey, just outside of what has currently been surveyed by *Travers bushfire & ecology.*

One (1) ROTAP flora species has also been recorded within the northern remnant near the *Rutidosis,* adjacent to the current study area, that being *Grevillea montana.* A few specimens were observed when following the Grey-crowned Babblers.

All species are listed in Table 3.1.

4.2.1 Local / Regional flora matters

Grevillea montana has been observed by Advitech in there study area which is a ROTAP species. A few specimens were recorded adjacent in the northern section of the site but individuals were not noted on the plans given there was no impact by development or APZs. A few more specimens were noted on the western side of the Spotted Gum planting area north of the large dam.

There are no *Grevillea montana* specimens expected to be impacted by any of the proposed bedding facilities and associated APZs.

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2016) indicated a list of species that have been recorded within a 10 km radius of the study area. Those species are considered for suitable habitat and potential to occur in Table A2.1 (Appendix 2).

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

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

Scientific name	*TSC Act*	Recorded on site (✓)	Potential to occur
Acacia bynoeana	E1	x	low
Callistemon linearifolius	V	x	✓
Eucalyptus glaucina	V	x	low
Grevillea parviflora subsp. *parviflora*	V	x	✓
Rutidosis heterogama	V	✓	recorded
Thesium australe	V	x	unlikely

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

One (1) state listed threatened flora species, *Rutidosis heterogama*, was observed during survey(s) undertaken. This species has have been assessed in detail within Appendix 3. Figure 3 shows the main part of the population that is impacted or is sighted adjacent to the proposed 420 bed rapid build.

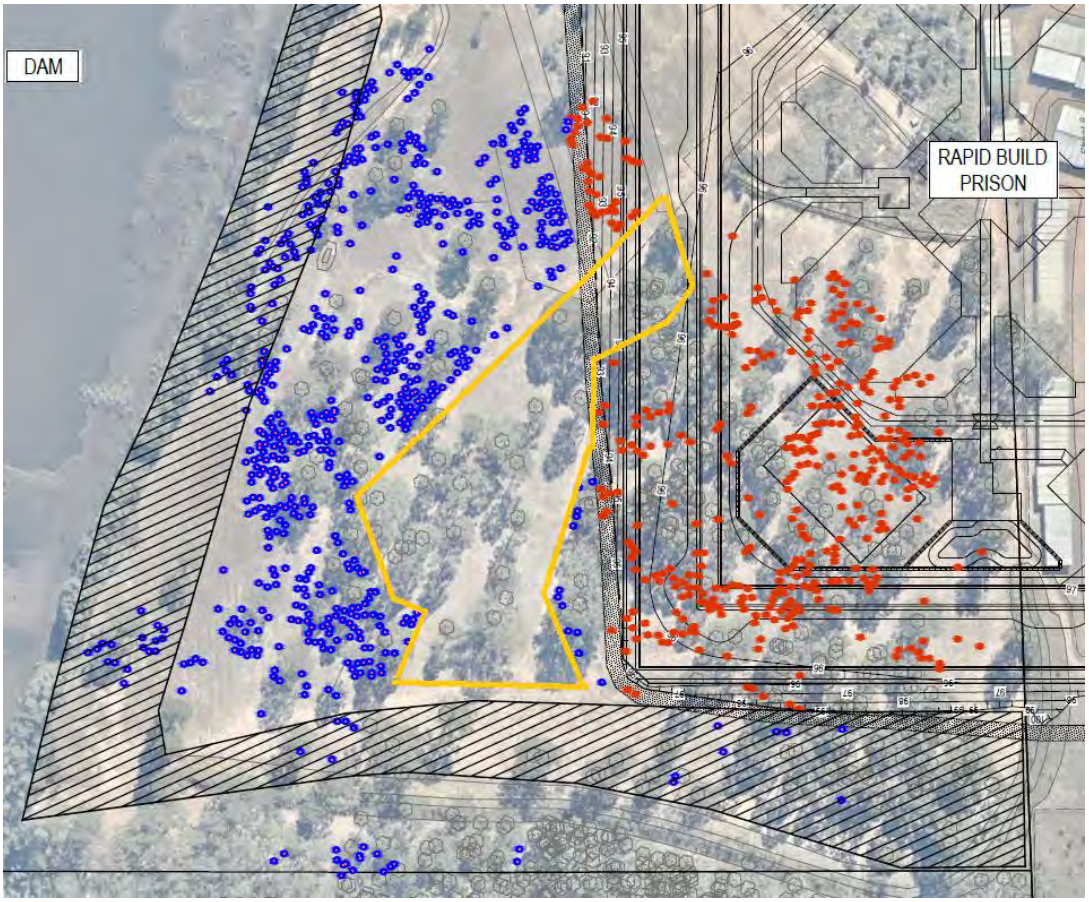

Figure 3 – Main population area of *Rutidosis heterogama* and location of 400 bed rapid build

The orange polygon represents an area where GPS survey was not mapped due to equipment malfunction, providing a gap in the GPS data. If the polygon is approximately 0.9 ha, of which 0.7 ha is retained and 0.2 ha is impacted, based on the density of the surrounding individuals (4,850 per 4.2 ha), the approximately individuals impacted is 250 versus 800 retained (to the nearest 50).

The 400 bed rapid build impacts upon 2,234 individuals in a surveyed population of 4,961. The estimated impact is a loss of 2,484 of 6,011 or 41%.

The proposed B400 facility will retain close to 60% of the population. Given that the population covers a large area estimated at 14 ha, with the impact upon 2.9 ha, the area of occupation is retained at 11.1 ha. Note that individuals are sparse to the south.

The area where the threatened species occurs is slashed regularly and has grazing animals on it regularly (mostly macropods and rabbits). These inhibit the potential for the plant to flower, be pollinated and set seed. These pressures will gradually lead to a decline in the population. A vegetation management plan is proposed that will remove these pressures and allow for potential density increases or ability for spread.

Additional responses on impacts to the species is provided in section 4.2.4 and in the 7 part test (Appendix 2). The conclusion upon the impact of the proposal upon this species in reference to the TSC Act is that it is unlikely to have a significant impact.

(b) Endangered flora populations (NSW)

There is one (1) known endangered population that occurs within the Cessnock LGA.

- *Cymbidium canaliculatum* population in the Hunter Catchment

The population in known to occur within dry sclerophyll forests and woodlands of NSW tablelands and western slopes, growing in the hollows of trees, fissures, trunks and forks. Specimens in the Hunter Catchment are most commonly associated with the tree species, *Eucalyptus albens*.

The study area is sited near the far southern extent of the species' geographic distribution.

Eucalyptus albens is absent however it is known to also grow on *Eucalyptus crebra* which is a dominant canopy species across the study area. There is also only one (1) noted record within a 10km, centred near Pokolbin approximately 6km west north-west. The record is from 1928 and has a 10km accuracy, so could actually be on / adjacent to the site, or as far as 16km away.

Given the above, the study area provides marginal habitat for species of this population to occur. The species was not observed and not likely to be impacted by the proposal.

(c) Endangered ecological communities (NSW)

Two (2) EECs were located onsite, namely;

- Lower Hunter Spotted Gum Ironbark Forest
- Swamp Oak Floodplain Forest

<u>Lower Hunter Spotted Gum Ironbark Forest</u>

Remnant vegetation across much of the study area forms part of the Lower Hunter Spotted Gum Ironbark Forest, in various conditions. This EEC will be impacted by the proposal. The north-eastern remnant is the best quality remnant on site. The current proposal does not have any impact upon this remnant. The 280 bed new build will impact upon fragmented EEC that is isolated, and is managed. There is very limited native mid-storey and groundcover vegetation in this location.

The 400 bed rapid build facility has been realigned following negotiations because of detrimental impacts upon the EEC, as well as Squirrel Glider corridors and *Rutidosis heterogama* specimens. The proposal will impact on moderate-good quality EEC which has been underscrubbed and maintained, but the ground layer is relatively intact.

The total impact from all three (3) facilities is 6.8 ha. This can be broken down into the following:

- 1.21 ha of moderate-good fully structured vegetation – all managed for APZs rather than fully removed.
- 4.05 ha of managed understorey and thinned canopy – combination of development and APZs.

- 1.54 ha of canopy only vegetation with no understorey – many of the trees are likely to be removed for proposed car parking facilities. In between the trees there is currently bitumen or gravel thus no opportunity for restoration.

Despite the impacts upon the EEC from the proposed developments and APZs, the proposal will not impact the vegetation in a way that would see a local extinction. One small patch of vegetation to the south of the 280 bed new build would become further fragmented and isolated. It currently exists as canopy trees with a fully managed understorey meaning that current practices do not allow for any natural restoration.

A vegetation management plan has been prepared that will assist in managing, protecting and enhancing the quality of habitats across the study area. It will also include areas of revegetation (mostly Lower Hunter Spotted Gum Ironbark Forest) that will link vegetation within the study area better for use as a corridor for the Squirrel Glider.

The proposed mitigation measures include revegetation of some 9.8ha of EEC revegetation works and another 12.3ha of enrichment planting works within existing Spotted Gum plantations. This will result in an effective increase the area of the EEC onsite and enrich the quality of habitat within existing revegetation areas.

Figure 4 – Lower Hunter Spotted Gum Ironbark Forest in the locality (olive green colour)

This EEC is very dominant in the landscape in and surrounding Cessnock above the floodplain of the Hunter River and tributaries. Figure 4 shows one of the broad-scale vegetation maps of the Lower Hunter Central Coast Regional Environmental Management Strategy (sourced from SIXmaps) which may have some inaccuracies, however the olive green colour typically indicated the EEC in the locality. There are possibly more areas between the site and the surrounding bushland to the east and south that form part of the EEC but have not been mapped where they are canopy only within urban landscapes.

Given the proposal is unlikely to isolate/fragment or reduce the local remnant to a size which cannot self-sustain, a significant impact will not occur.

Swamp Oak Floodplain Forest

The Swamp Oak Floodplain Forest only occurs in a narrow band around the large dam edge and along low lying ground running north or north-west to the boundary. It is also likely to occur just to the north of the study area in nearby drainage lines that grade between Swamp Oak Floodplain Forest and River-flat Eucalypt Forest on Coastal Floodplains. No direct impact is considered likely upon this EEC. The closest development area is the 400 bed rapid build. The proposed APZ will be a minimum of 45m from the EEC. The proposal is not expected to have direct or indirect impacts upon this community that would place it at risk of local extinction.

4.2.3 Endangered wetland communities

A number of wetland communities that have been listed as an 'endangered ecological community' under the NSW TSC Act. Those wetland communities must be given due consideration in accordance with the NSW Wetlands Policy (2010) and buffers provided in accordance with the NSW DPI - Office of Water - Controlled Activity Guidelines 2012.

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

Swamp Oak Floodplain Forest occurs surrounding the larger dam and extends along or near to drainage lines or paths of overland flow to the north-west of the dam. The proposal will not have any direct impact upon this community.

In accordance with the NSW DPI - Office of Water - Guidelines for Controlled Activities a standardised buffer of 40m applies to these communities subject to offset provisions. Where

they are mostly cleared, highly fragmented or highly disturbed, consolidation and management in accordance with a Vegetation Management Plan is recommended. The buffers provided are to be considered in the landscape context and consultation with NSW DPI – NSW Office of Water undertaken to confirm the appropriateness of setbacks.

The proposed APZ will not applied to the community on the eastern side of the large dam, however, there is substantial protection to the north, south and western sides of the dam that will allow for sufficient protection of this community in the locality.

4.2.4 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 subject site provides varying levels of potential habitat for the following nationally listed threatened flora species:

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

Scientific name	*EPBC Act*	Recorded on site (✓)	Potential to occur
Acacia bynoeana	V	x	low
Eucalyptus glaucina	V	x	low
Grevillea parviflora subsp. *parviflora*	V	x	✓
Rutidosis heterogama	V	✓	recorded
Thesium australe	V	x	unlikely

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

Rutidosis heterogama

The concept of an 'important population' is central to this assessment and is described in the Environment Protection and Biodiversity Conservation Act 1999 Matters of National Environmental Significance Significant Impact Guidelines 1.1 as:

> 'a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:
>
> - key source populations either for breeding or dispersal;
> - populations that are necessary for maintaining genetic diversity; and/or
> - populations that are near the limit of the species range.'

To determine whether the population of *Rutidosis heterogama* qualifies as an important population, its biology and wider distribution should be considered.

The distribution of the species is largely coastal NSW from the Central Coast near Wyong to northern NSW and inland to Howes Valley and Torrington. The larger populations are centred upon the Hunter Valley, particularly close to Kurri Kurri as well as the Maclean Valley.

The location of the specimens potentially impacted are not at their limits of distribution.

The pappus (structures at the top of Asteraceae seed to aid in wind dispersal) on Rutidosis seed is in the form of rudimentary scales and seed are dispersed within a short distance (0.5 m of the plant) and generally germinate within that area. Seed are only viable in soil for about four months.

Pollinators are native bees and other insects. Genetic studies have also shown the potential for locally adaptive genotypes in geographically separated populations. This being so, any group of *Rutidosis heterogama* plants existing in genetic isolation from any others would be an important population because of the potential uniqueness of its genotype.

With seed dispersal being limited to such short distances and having a short period of viability, genetic transfer between populations would be restricted to pollen transfer. Genetic isolation would occur at separation distances beyond which pollen would be transferred. Major roads would be a large barrier to populations because pollinators often will not cross.

A few individuals have been recorded in the northern bushland patch but will not be impacted by the proposal. Given the separation of these to the large patch east of the dam (approximately 900m), it is possible that these are two (2) distinct populations. It appears to be quite dependent upon the distance the pollinator is likely to fly. The specimens recorded adjacent to the south of the site have contiguous bushland and a separation distance of at least 50m. These would form part of the same population. Surveys have not continued more than 100m from the site however the bushland continues a further 300m, thus the population would be larger than has been surveyed to date.

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

- lead to a long-term decrease in the size of an important population of a species;

  The surveyed population that may be impacted contains an estimated 6,011 individuals. It is recognised that the population continues further to the south beyond what has been surveyed for to date, therefore the proportion of individuals impacted would be inflated.

  Based upon the estimate above, the action would result in the loss of 2,484 plants or about 41% of this population. Against that loss, a large portion of the remainder of the population will be conserved in perpetuity which could potentially facilitate an increase in numbers or an increase in density. It is unlikely that the action will result in a long-term decrease in the size of this population.

- reduce the area of occupancy of an important population;

  The total area of occupancy, being the area in which the species occurs is 14 ha which includes the full extent of observed individuals as well as the contiguous vegetation to the south (to the northern tip of O'Shea Circuit) of the site. The action will have an impact of approximately 2.9 ha (including cut and fill areas and asset protection zones), or ~20% of the area.

  There is adequate habitat available into which the population could expand if conditions were made suitable and managed in a similar manner to that currently undertaken. Notwithstanding that there could be potential expansion, it is not likely to

be equivalent in area to that being removed or impacted. The area of occupancy for this population will be reduced.

- fragment an existing important population into two or more populations;

  The action occurs on one side of the population rather than crossing the full extent and does not completely surround the area of occupation. As such, the action will not fragment the population into two or more populations.

- adversely affect habitat critical to the survival of a species;

  This concerns the species as a whole and the action would not adversely affect habitat critical to its survival as the species is far too widespread in the locality.

- disrupt the breeding cycle of an important population;

  Although there will be a reduction in species numbers and occupation area, just over 11 ha will remain. It is unlikely that the breeding cycle of the remaining population would be altered. A vegetation management plan could assist by removing slashing (understorey maintenance) and grazing animals within areas outside of the asset protection zone to ensure that individuals have the opportunity to flower and produce seed. Current management practices allow for very little of this to occur.

- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

  Just over 11 ha of 14 ha of known habitat will be retained post construction. Whilst there will be a reduction in numbers of individuals, the removal of an understorey maintenance regime would greatly improve the potential longevity of the population. It is expected that the numbers of individuals will decrease in the short term only and restoration works including soil translocation will be undertaken to increase the area of habitat and the population.

- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

  A vegetation management plan will be enacted to remove invasive species if they were to persist. There are currently no major weed infestations within the area of occupation.

- introduce disease that may cause the species to decline;

  The action would not result in any disease being introduced that may cause the species to decline. Provided that retained areas of occupation are protected by temporary fencing during construction, the spread of fungal disease like *Phytophthora* is unlikely.

- interfere substantially with the recovery of the species.

  It is unlikely the action proposed will interfere with the species' recovery post construction. Currently the area of occupation within the Cessnock Correctional Facility ground is maintained, ie. regularly slashed. Regular slashing poses a risk to local extinction when the plants do not have the ability to flower and set seed, or pollinated. The removal of slashing post construction, to be managed under a

vegetation plan will provide much more long-term assurance to the remaining population.

Conclusion

The action will reduce the area of habitat by approximately 20%. Currently the area of occupation within the Cessnock Correctional Facility ground is maintained, ie. regularly slashed. Regular slashing poses a risk to local extinction when the plants do not have the ability to flower and set seed, or pollinated. The removal of slashing post construction, to be managed under a vegetation plan will provide much more long-term assurance to the remaining population.

Whilst a substantive umber of plants is being lost, the impact has been limited and is unlikely to cause a significant impact that could threaten the extinction of the local population. Furthermore soil translocation, revegetation and ongoing management suited to this species will be implemented and motored by the project ecologist.

Given that a not significant impact will be caused a referral under the EPBC Act is not required.

(b) Endangered ecological communities (national)

Lower Hunter Spotted Gum Ironbark Forest in not listed under the EPBC Act, but may conform to the nationally critically endangered listed Central Hunter Valley eucalypt forest and woodland ecological community. The ecological community occurs in the Hunter Valley Region (including the Goulburn Valley) - the Hunter River catchment in north east New South Wales. Much of it occurs in, or close to, the Central Hunter Valley, mainly in Muswellbrook, Singleton and Cessnock Local Government Areas.

A full description of the community can be found at the following website:
http://www.environment.gov.au/system/files/resources/5d6386ad-ce46-4b33-993f-8518ab9c972a/files/central-hunter-valley-eucalypt-forest-guide.pdf

Section 1.6.1 of the following website describes the relationship between state listed communities, versus those under the EPBC listing:
http://www.environment.gov.au/biodiversity/threatened/communities/pubs/130-conservation-advice.pdf

The Central Hunter Valley eucalypt forest and woodland ecological community corresponds, in large part, to three New South Wales listed ecological communities (NSW Scientific Committee, 2010a, 2010b, 2010c). The communities are the:

- Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions (Endangered);
- Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions (Endangered); and
- Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion (Vulnerable).

There are some outliers of the ecological community which occur in the Lower Hunter Valley region. These are recognised as a fourth NSW vegetation type, the 'Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion' listed as endangered in NSW (NSW Scientific Committee, 2010d). These 'Lower Hunter' outliers typically occur in elevated areas on soils derived from Permian sedimentary strata and meet the other Key diagnostic

characteristics and Condition thresholds of the Central Hunter Valley eucalypt forest and woodland. These occurrences are included in the ecological community.

However, much of the 'Lower Hunter Spotted Gum-Ironbark Forest' has *Allocasuarina torulosa* (forest oak), and/or *Eucalyptus acmenoides* (white mahogany) and/or *E. fibrosa* (red/broadleaved ironbark) amongst its canopy species. These areas are excluded from the Central Hunter Valley eucalypt forest and woodland ecological community. The report notes that these are contra-indicative species, and where they occur, they do not form part of the EPBC listing. *E. fibrosa* is a dominant canopy species throughout much of the remnant patches, and *Allocasuarina littoralis* was an occasional species where there was remnant mid-storey. As such, the vegetation on site does not appear to fit the definition of the community as described in detail in the previously listed website above.

4.3 Fauna

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

4.3.1 Fauna habitat

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

Table 4.3 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate	Steep	Drop-offs
Vegetation structure				
Closed Forest	Open Forest ✓	Woodland ✓	Heath	Grassland ✓
Disturbance History				
Fire	Under-scrubbing ✓	Cut and fill works		
Tree clearing ✓	Grazing			
Soil Landscape				
DEPTH:	Deep ✓	Moderate ✓	Shallow	Skeletal
TYPE:	Clay	Loam	Sand	Organic
VALUE:	Surface foraging ✓	Sub-surface foraging ✓	Denning/burrowing ✓	
WATER RETENTION:	Well Drained ✓	Damp / Moist	Water logged	Swamp / Soak ✓
Rock Habitat				
None present				
Feed Resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias ✓	Melaleucas ✓	
	Banksias	Acacias ✓		
SEEDING TREES:	Allocasuarinas ✓	Conifers ✓		
WINTER FLOWERING EUCALYPTS:	C. maculata ✓	E. crebra ✓	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta	E. tereticornis	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn ✓	Winter ✓	Spring ✓	Summer ✓
OTHER:	Mistletoe ✓	Figs / Fruit	Sap / Manna	Termites ✓
Foliage Protection				
UPPER STRATA:	Dense ✓	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate	Sparse ✓	
PLANT / SHRUB LAYER:	Dense	Moderate ✓	Sparse ✓	
GROUNDCOVERS:	Dense ✓	Moderate ✓	Sparse ✓	
Hollows / Logs				
TREE HOLLOWS:	Large ✓	Medium ✓	Small ✓	
TEE HOLLOW TYPES	Spouts / branch ✓	Trunk ✓	Broken Trunk ✓	Basal Cavities ✓	Stags ✓
GROUND HOLLOWS:	Large	Medium	Small ✓	

Vegetation Debris						
FALLEN TREES:	Large		Medium		Small ✓	
FALLEN BRANCHES:	Large		Medium		Small ✓	
LITTER:	Deep		Moderate ✓		Shallow ✓	
HUMUS:	Deep		Moderate		Shallow ✓	
Drainage Catchment						
WATER BODIES	Wetland(s)	Soak(s) ✓	Dam(s) ✓	Drainage line(s) ✓	Creek(s)	River(s)
RATE OF FLOW:	Still ✓		Slow		Rapid	
CONSISTENCY:	Permanent ✓		Perennial		Ephemeral ✓	
RUNOFF SOURCE:	Urban / Industrial	Parkland ✓	Grazing		Natural ✓	
RIPARIAN HABITAT:	High quality	Moderate quality ✓	Low quality ✓		Poor quality	
Artificial Habitat						
STRUCTURES:	Sheds ✓		Infrastructure ✓		Equipment	
FOREIGN MATERIALS:	Sheet		Pile / refuse			

Four main separate habitat areas within the study area have been identified:

Western Vegetation: This vegetation consists of spotted gum plantations with all trees still at a relatively young stage of growth but now provide foraging habitat. This area has almost no shrub layer or terrestrial habitats such as fallen trees or branches. This area provides only foraging opportunity for nectivorous birds and arboreal mammals. No hollow trees were observed within this patch.

Northern vegetation: This vegetation is a relatively intact stand of mixed eucalypt dominated by Spotted Gum and Narrow-leafed Ironbark (*E. crebra*) providing foraging opportunity for nectivorous birds and arboreal mammals. The shrub layer is also well established consisting of mixed native species. Hollow trees are in low supply as is ground fauna habitats such as fallen timber logs etc. HT2 a spotted gum located in the SW corner of this patch provides larger hollows suitable for Masked Owl. This tree was spotlighted however no fauna was observed leaving the hollows.

Dam and drainage area: This area is not part of the development landscape. The dam provides all usual aquatic habitats with reed beds and floating lily vegetation and large areas of clear water. The vegetation immediately surrounding the dam and lower depressions consists of regrowth Casuarina glauca. No habitat trees were observed within this area.

Southern vegetation: This is the remaining vegetation patches across the southern study area consisting of scattered Ironbark's and Spotted Gums with a highly disturbed managed understorey. The shrub layer and ground layer offers little fauna habitat potential other than for herbivorous mammals and the larger ground foraging bird species. Noisy Miners dominate this area thereby reducing bird diversity. A few large seeding *Allocasuarina torulosa* trees were present however chewed cones were not identified. Two hollow trees HT4 & HT5 were identified within this patch. Spotlighting identified no nocturnal arboreal fauna within these trees. HT5 could be considered as a possible owl roost site.

4.3.2 Habitat trees

A complete assessment of the location of habitat trees and the size of hollows within the study area was undertaken as part of surveys. Table 4.4 below provides hollow-bearing tree data and Figure 2 provides locations of habitat trees. Habitat trees HT6-21 were well away from the subject site and therefore details on tree dimensions were not required. Figure 5 shows locations of habitat trees considered potentially suitable for Squirrel Glider. These include trees indicated with an "S" below. Trees indicated with a "*" below are likely to require removal for the proposal.

Table 4.4 – Habitat tree data

Tree No	Scientific Name	DBH (cm)	BD (cm)	Height (m)	Spread (m)	Vigour (%)	Hollows & Other Habitat Features Recorded
HT1	*E crebra*	45	55	15	10	30	1x 5-10cm branch
HT2 S	*C maculata*	75	90	23	8	40	4x 20-30cm broken trunk & trunk
HT3 *	*E crebra*	90	90	25	25	75	1x 30-40 trunk base
HT4 *	*E crebra*	65	85	18	15	70	3x 0-5cm branch
HT5 S	*E crebra*	110	150	25	20	70	2x 5-10cm branch, 1x 30-40cm broken trunk
HT6 S	stag	-	-	-	-	-	2x 5-10cm trunk/branch
HT7 S	*C maculata*	-	-	-	-	-	2x 15-20cm branch (bees), 3x 20-30cm trunk/branch
HT8 S	*E crebra*	-	-	-	-	-	2x 5-10cm branch, 1x 30-40cm trunk (bees)
HT9 S	stag	-	-	-	-	-	1x 10-15cm trunk
HT10 S	*E crebra*	-	-	-	-	-	1x 5-10cm trunk
HT11 S	*E punctata*	-	-	-	-	-	3x 10-15cm branch, 3x 20-30cm branch
HT12 S	*C maculata*	-	-	-	-	-	1x 5-10cm trunk split
HT13 S	*E fibrosa*	-	-	-	-	-	1x 5-10cm trunk/branch, 1x 10-15cm branch
HT14 S	*E crebra*	-	-	-	-	-	2x 0-5cm branch
HT15 S	*E crebra*	-	-	-	-	-	2x 0-5cm branch
HT16 S	*E punctata*	-	-	-	-	-	2x 5-10cm trunk/branch, 1x 10-15cm trunk, 3x 15-20cm branch/trunk
HT17 S	*E moluccana*	-	-	-	-	-	1x 0-5cm trunk
HT18 S	stag	-	-	-	-	-	1x 10-15cm trunk
HT19 S	stag	-	-	-	-	-	2x 5-10cm branch, 1x 15-20cm branch
HT20 S	e crebra	-	-	-	-	-	1x 5-10cm entry nestbox (bees)
HT21 S	e crebra	-	-	-	-	-	1x 5-10cm entry nestbox (bees)
HT 1A S *	*E crebra*	85	95	25	18	60	1x 10-15cm entry nestbox
HT 2A *	*E crebra*	83	90	30	25	75	2x 0-5cm exfoliating bark
HT 3A *	*E crebra*	95	125	30	17	40	3x 0-5cm exfoliating bark

Two hollow-bearing trees within the study area HT2 & HT5 are considered suitable for threatened owls. These are considered most suitable for Masked Owl given the open woodland habitats however such birds typically require greater numbers of large hollows for the male to utilise as satellite roosts around the female. Masked Owl also has not been previously recorded within 10km and is considered unlikely to occur. Therefore, these trees are considered unlikely to be utilised by threatened owls. Both of these trees may be retained as part of the proposal.

Three hollow-dependent threatened fauna species were recorded present during survey by *TBE* including the Large-footed Myotis, East-coast Freetail Bat and Squirrel Glider. The Large-footed Myotis was only recorded from a single recorded pass over the dam and is therefore only identified to a 'possible' level of certainty. Two (2) additional hollow-dependent threatened fauna species Eastern Falsistrelle and Greater Broad-nosed Bat were also recorded present by *Advitech* (2012).

The East-coast Freetail Bat however was recorded to a high level of activity also suggesting that a roosting site may be located nearby. Hollows recorded present within the subject site are generally branch spouts or exfoliated bark and not considered ideally suitable for this species.

Therefore if a roost is located nearby it is not expected to be located within the proposed development landscape.

One nest box located within the subject site is included in the hollow data. This box may be relocated or replaced as part of the proposal. It will be recommended that all hollow removed are either cut and relocated into surrounding recipient trees (if a good quality cavity) or otherwise replaced with a nest box in retained bushland areas.

In consideration to the hollow tree data, five (5) hollow-bearing trees will be likely removed by the proposal containing 3 small hollows, approximately 5 exfoliating bark crevices, 1 nest box and 1 large tree base hollow. The nest box may be relocated / replaced and the large tree base hollow is not likely to be utilised in such a disturbed landscape. The small spout hollows and exfoliated bark are not expected to be of importance to threatened fauna species recorded.

4.3.3 Squirrel Glider habitat assessment

Given the suitability of habitat present and known nearby records Squirrel Glider (*Petaurus norfolcensis*) was initially targeted by call-playback techniques and spotlighting through the study area. At the time of these initial field observations it appeared as though the south-west subject site (containing the proposed 400 bed security zone) contained a high representation of mature Spotted Gum trees which are an important winter-spring foraging opportunity for nectarivores and large mature trees provide the most abundant yields.

Subsequent to this observation and adjacent records of Squirrel Glider within the reserve and golf course to the south, further target survey and habitat assessment was undertaken. The main objectives of this was to determine if Squirrel Glider family groups still persist in the locality and the comparable extent of Spotted Gums and other nectar foraging opportunities in the nearby local surrounds.

The Squirrel Glider was recorded during targeted spotlighting at five locations within the study area and nearby surrounds. At one location two Gliders were observed. Based on the distance and timing between observations it is considered that these gliders were of possibly three or more likely four separate family groups.

Initial field assessments revealed that the south-western portion of the subject site (the 400 bed facility) was proposed over mature Spotted Gum and Ironbark trees within the landscape. Further habitat assessment revealed that mature Spotted Gum trees are not otherwise well represented elsewhere in the nearby locality (refer to the Squirrel Glider habitat assessment on Figure 4). Having said this Spotted Gums area very well represented within the two large plantation areas within the study area, albeit maturing specimens. Elsewhere within the local surrounding landscape other trees species dominate presence.

Spotted Gum trees represent one of three potential winter flowering myrtaceous trees in the local landscape which is an important habitat requirement for Squirrel Gliders. This observation, combined with the recorded presence of *Rutidosis heterogama* throughout this same subject site area prompted a review of the proposed footprint. Subsequent to this the footprint for the 400 bed facility has been moved 110m east and 40m north primarly to retain *Rutidosis heterogama.* This in turn has maintained sufficient mature Spotted Gum trees in this location to conclude that the proposed development will not likely significantly impact on the local Squirrel Glider population.

The habitat assessment for Squirrel Glider did bring to light that the local population, whilst represented by a number of nearby family groups, is clinging onto available habitat opportunities. There is a lower density of hollows throughout the local landscape to ideally

support a healthy Squirrel Glider population. Recent habitat removal to the south is also known to have removed a den tree from anecdotal information.

Further to this the local connectivity is becoming increasingly fragmented and several locations exist where it is apparent that gliders can only make passage by along the ground movements. This is evident in the north-eastern corner of the golf course where one glider was observed. Some nest boxes are present in this relatively small patch however there is no gliding connectivity in or out.

Based on the habitat assessment and survey results it was clear that the proposed facilities could make a significant contribution to the long term viability of the local Squirrel glider population such as with the installation nest boxes in immature forest areas as well as providing plantings for future gliding connectivity between foraging areas. Squirrel Gliders readily take to nest boxes and they would be ideal within the plantation areas which have good foraging potential with no denning opportunities.

The plantation areas if also supplemented with more diverse foraging shrubs (banksias and acacias) may provide higher carrying capacity of the vegetated landscape and support further family groups to better assure the local population. This is considered an important consideration based on the dwindling denning and connective habitat now notably available. Further habitat removal and separations could be the difference in assuring long-tern presence.

The proposed mitigation measures include revegetation of some 9.8ha of EEC revegetation works and another 12.3ha of enrichment planting works within existing Spotted Gum plantations. This will result in an effective increase the area of the EEC onsite and enrich the quality of habitat within existing revegetation areas.

Where plantings are placed to increase local connectivity, these should be represented by local native trees that provide various year-round nectar foraging opportunities. Plantings along the south-eastern site boundary to the patch within the north-east of the golf course (described above) would be highly beneficial.

4.3.4 Local fauna matters

The *LHCCREMS* survey guidelines for Cessnock does not list any locally significant fauna species for extra consideration. It is considered that the Brown Toadlet, Hoary-head Grebe, Rose Robin and Royal Spoonbill may be considered as notable local species. Of these, breeding habitat only for Brown Toadlet will be removed.

4.3.5 State legislative fauna matters

(a) Threatened fauna species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2016) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the subject site.

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

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

Common name	TSC Act	Potential to occur
Grey-crowned Babble	V	recorded
Grey-headed Flying-fox	V	recorded
East-coast Freetail Bat	V	recorded
Eastern Falsistrelle	V	recorded
Little Bentwing-bat	V	recorded
Eastern Bentwing-bat	V	recorded
Large-footed Myotis	V	recorded
Greater Broad-nosed Bat	V	recorded
Eastern Cave Bat	V	recorded
Squirrel Glider	V	recorded
Little Eagle	V	✓
Square-tailed Kite	V	✓
Little Lorikeet	V	✓
Swift Parrot	E	✓
Brown Treecreeper	V	✓
Speckled Warbler	V	✓
Regent Honeyeater	E4A	✓
Varied Sittella	V	✓
Australasian Bittern	E	low
Spotted Harrier	V	low
Comb-crested Jacana	V	low
Powerful Owl	V	low
Black-chinned Honeyeater	V	low
Yellow-bellied Sheathtail-bat	V	low
Large-eared Pied Bat	V	low
Green and Golden Bell Frog	E	unlikely
Freckled Duck	V	unlikely
Black-necked Stork	E	unlikely
Black Bittern	V	unlikely
Gang-gang Cockatoo	V	unlikely
Glossy Black-Cockatoo	V	unlikely
Barking Owl	V	unlikely
Masked Owl	V	unlikely
Hooded Robin	V	unlikely
Flame Robin	V	unlikely

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

Eight (8) threatened fauna species including Sqirrel Glider (*Petaurus norfolcensis*), Grey-crowned Babbler (*Pomatostomus temporalis*), Grey-headed Flying-fox (*Pteropus poliocephalus*), East-coast Freetail Bat (*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*), Little Bentwing-bat (*Miniopterus australis*), Eastern Cave Bat (*Vespadelus troughtoni*) and Large-footed Myotis (*Myotis macropus*) were recorded within the study area during surveys. The Eastern Bentwing-bat was recorded only to a 'probable' level of certainty and the Large-footed Myotis was recorded only to a 'possible' level of certainty.

Surveys by *Advitech* (2012 & 2016) also recorded bat calls consistent with Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). This is a total of ten (10) threatened fauna.

These recorded species have been assessed in detail within Appendix 3. The impact assessment for these species has concluded a not significant impact.

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

(b) Endangered fauna populations (NSW)

There are no endangered fauna populations within the Cessnock 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 subject site is required to be considered under SEPP 44 as it falls within the Cessnock LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the subject site is greater than 1 hectare, hence Part 2 – Development Control of Koala Habitats, of the Policy applies.

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

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

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

Step 1 – Is the land PKH?

One Koala food tree species – Grey Gum (*Eucalyptus punctata),* as listed on Schedule 2 of SEPP 44 – was recorded within the study area. These trees comprised less than 15% of the total number of trees within the Spotted Gum Ironbark Forest vegetation community in the northern portion of the study area. As such the study area is not considered to comprise 'potential Koala habitat' as defined under SEPP 44 and no further assessment under this policy is required.

4.3.6 National environmental significance - fauna

(a) Threatened fauna species (National)

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

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

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

Common name	EPBC Act	Potential to occur
Grey-headed Flying-fox	V	recorded
Swift Parrot	E	✓
Regent Honeyeater	CE	✓
Australasian Bittern	E	low
Large-eared Pied Bat	V	low
Green and Golden Bell Frog	V	unlikely

One (1) nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging within the subject site during survey. This is a state listed fauna species and a detailed assessment under state legislation (EPA Act 1979) is undertaken within the 7 part test (Appendix 3).

Grey-headed Flying-fox

An individual Grey-headed Flying-fox was recorded foraging on flowering Spotted Gum at two separate locations within the subject site during recent 2016 winter survey. There is no likelihood of this species utilising the subject site for roosting and subsequent breeding habitat. Mature foraging trees utilised for seasonal foraging will therefore be removed as part of the proposal.

The Significant Impact Criteria for a vulnerable species listed under the EPBC Act 1999 (Appendix 4) was reviewed to assess the impacts on this species as a result of the proposed development layout. As the subject site does not contain any likely roosting or subsequent breeding habitat and foraging habitat will remain well represented in the locality, it is concluded that there will not be any significant impact on this species, or other nationally listed threatened fauna species with potential to occur, as a result of the proposal.

(b) Protected migratory species (National)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10km radius of the subject site. The habitat potential of migratory species is considered in Table A2.3 (Appendix 2). The habitat potential of threatened migratory species is considered in Table A2.3 Table A2.2 (Appendix 2).

One (1) nationally protected migratory bird species the Great Egret (*Ardea alba*) was recorded present during the fauna survey. The impact assessment for this species has concluded a not significant impact.

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

4.4 Vegetation connectivity

The vegetation within the study area is already in a highly fragmented state from areas of contiguous vegetation in the surrounding locality. The connectivity that does remain however is of likely local importance to Squirrel Glider. This species was known to occur with several records to the south from 2007. Several additional records to the north and south of the study area was also recorded during recent habitat assessment surveys indicating that this population persists in the immediate locality.

The habitat assessment for Squirrel Glider provided in Section 4.3.3 and depicted on Figure 4 provides an assessment of connectivity specifically for the Squirrel Glider. Figure 4 shows the connectivity for Squirrel Glider as indicated by the mapped grey polygons. Figure 4 indicates areas accessible through gliding connectivity based on the *Draft Squirrel Glider Planning & Management Guidelines* (LMCC 2015). These guidelines indicate that the average gap crossing distance between trees for gliders is 1.8 times launch height minus 2m. Furthermore, road gaps >35 m wide are considered a potential barrier to crossing.

Locations providing a barrier to gliding opportunity were noted in order to map the potential local connectivity. The lighter grey polygons on Figure 4 therefore alternatively indicate isolated patches from gliding. Interestingly a glider was recorded within one of these isolated patches within the golf course area and therefore gliders are suspected of making movements along the ground in this location to access alternate foraging areas. It is likely that predators such as cats and foxes are not successful in the open managed areas of the study area and golf course as gliders can make along the ground passage with clear view of terrestrial predators.

As the proposal will remove mature winter foraging habitat for the Squirrel Glider it is recommended that this is offset by the benefit of planting of trees in order to enhance future connectivity for Gliders. These trees should ideally be potential foraging trees with consideration to year-round foraging floristics. The locations of these plantings should be prioritised to consider re-connecting the habitat areas mapped on Figure 4.

The isolated patch in the golf course where a Squirrel Glider was recorded should be connected in some way to other vegetation stands and the subject can improve connectively with strategy tree plantings. Tree plantings along the south-eastern boundary of the Correctional Facility site would be a high value offset to habitat loss elsewhere. Other connective improvement opportunities are indicated through the study area and should be detailed in a Habitat Management Plan or Vegetation Management Plan.

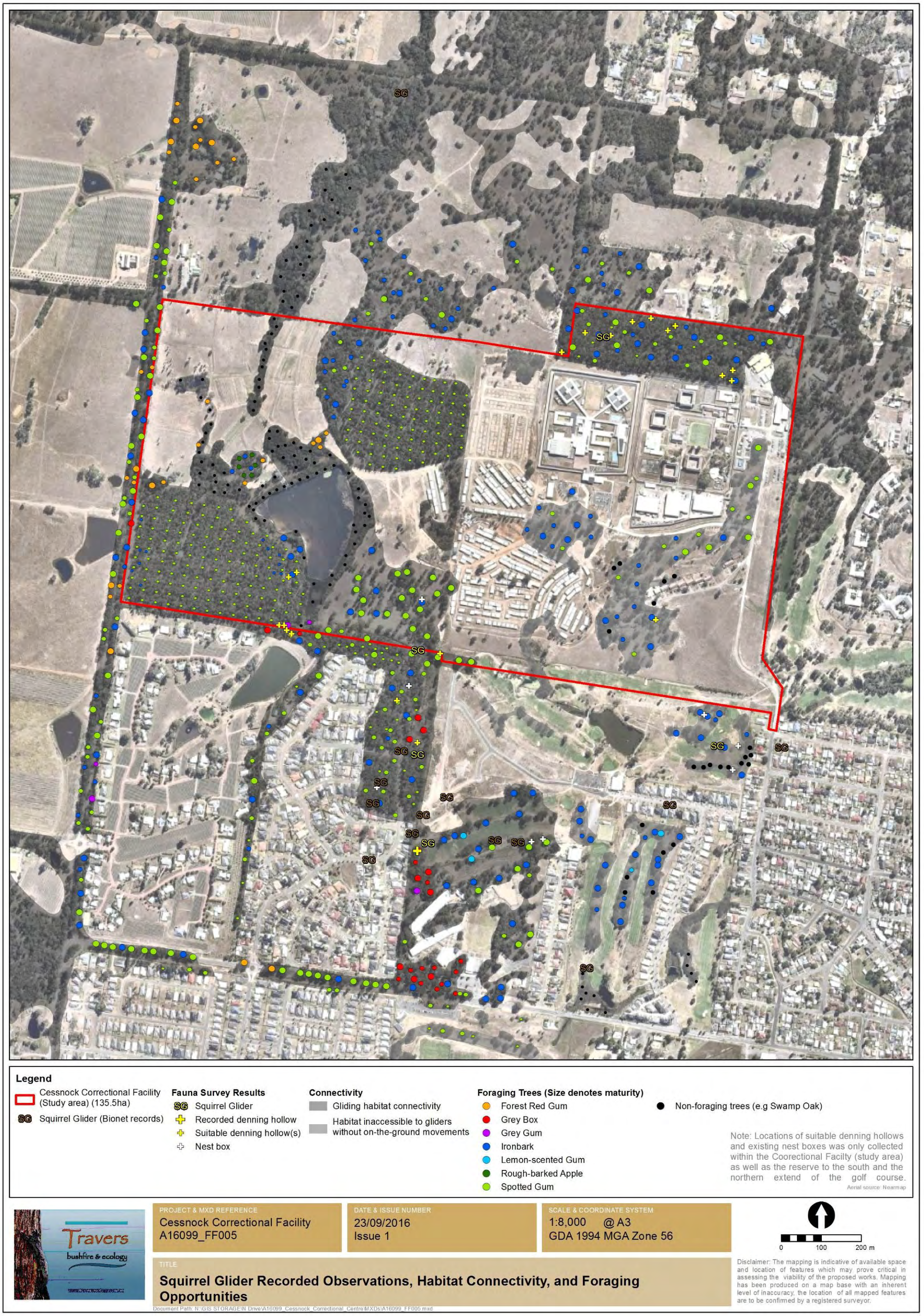

Figure 5 – Squirrel Glider recorded observations, habitat connectivity and foraging opportunities

Conclusion 5

Travers bushfire & ecology has been engaged to undertake a flora and fauna assessment for several proposed facilities for future housing of inmates at Cessnock Correctional Centre. There are three (3) proposed buildings, housing 280 beds, 320 beds and 400 beds (1,000 in total).

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

5.1 Legislative compliance

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

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995*, eight (8) threatened fauna species including Squirrel Glider (*Petaurus norfolcensis*), Grey-crowned Babbler (*Pomatostomus temporalis*), Grey-headed Flying-fox (*Pteropus poliocephalus*), East-coast Freetail Bat (*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*), Little Bentwing-bat (*Miniopterus australis*), Eastern Cave Bat (*Vespadelus troughtoni*) and Large-footed Myotis (*Myotis macropus*), one (1) threatened flora species, *Rutidosis heterogama* and one (1) EEC, Lower Hunter Spotted Gum Ironbark Forest were recorded or observed by *TBE* within the study area.

The Eastern Bentwing-bat was recorded only to a 'probable' level of certainty and the Large-footed Myotis was recorded only to a 'possible' level of certainty. Surveys by *Advitech* (2012 & 2016) also recorded bat calls consistent with Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). This is a total of ten (10) threatened fauna recorded within the study area indicating that the landscape contains important habitat for fauna species.

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

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, one (1) threatened fauna species, Grey-headed Flying-

fox (*Pteropus poliocephalus*), one (1) protected migratory bird species Great Egret (*Ardea alba*), one (1) threatened flora species, *Rutidosis heterogama,* and no EECs listed under this Act were recorded within the study area.

The proposed development was not considered to have a significant impact on matters of national environmental significance. A referral to the Department of Environment under the EPBC Act is not required.

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

5.2 Observations

Vegetation in the eastern portion of the study area is of lower conservation value, although forming part of the EEC Lower Hunter Spotted Gum Ironbark Forest. These patches of vegetation are fragmented and currently have no connective value. The vegetation consists almost exclusively of canopy trees with a low number and percentage of native understorey species due to ongoing slashing, or are contained in landscaping beds.

Vegetation along the north-eastern boundary is of higher conservation value being Lower Hunter Spotted Gum Ironbark Forest, and containing a suite of threatened fauna, a few individuals of the threatened plant *Rutidosis heterogama,* and the ROTAP species *Grevillea montana.* Much of the vegetation is of good quality, although the eastern part contains patches of exotic species.

The existing patches of planted vegetation comprising mostly Spotted Gums in the western portion of the study area have habitat value because they are quite large, totalling over 17 ha, providing shelter and foraging opportunities. Because the plantation is still young, the trees have not developed hollows thus not providing much in the way of any breeding opportunities.

The vegetation to the immediate east of the large dam has high conservation value despite being managed. It contains a few hollow-bearing trees, is part of the EEC Lower Hunter Spotted Gum Ironbark Forest, and contains a large population of the threatened species *Rutidosis heterogama.* A number of threatened bat species were recorded in this area, and Squirrel Glider was recorded on the southern boundary which was also found further south.

Despite a modified and fragmented landscape within the surrounds of the owned lands by the Correctional Facility, these lands provide specific habitat features of value to threatened fauna species recorded or with potential to occur. Such habitats support a notable high diversity of fauna species that have been recorded during surveys of the study area and immediate surrounds. Such habitat features specifically include:

- High quality native habitat patches (particularly to the north) where understorey structure and deadwood habitat supports important habitat for the Grey-crowned Babbler.
- A large dam providing foraging habitat for the Large-footed Myotis as well as other microbats, wading birds and waterfowl.
- Plantation areas acting in association to the naturally occurring local Spotted Gum trees providing a potential valuable winter flowering resource for nectarivor species

- Hollows of various sizes occurring in generally high density in remnant patches of Lower Hunter Spotted Gum Ironbark Forest and low density in all other vegetated patches.
- Fragmented landscape for Squirrel Glider with recoded use of such patches indicating across the ground movements. The local foraging habitat appears well represent for year-round floristic foraging for this species however denning and connectivity opportunities are noticeably dwindling with ongoing habitat clearance in the immediate locality. This appears to be likely putting pressures on the remaining family groups that persist in the locality.
- Cross-site connectivity for gliders and birds to access the local adjacent habitats particularly to the north.

5.3 Potential ecological impacts

The direct, indirect and cumulative impacts of the proposal have been carefully considered in Section 5.3 of this report.

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

- Removal/modification of 6.8 ha of EEC, Lower Hunter Spotted Gum Ironbark Forest.
- APZ impacts of 0.53 ha of Spotted Gum Plantation for the 320 bed build.
- Possible loss of small dam near north-west corner of the 320 bed build.
- Loss of up to 41% of the *Rutidosis heterogama* population by the 400 bed build (~10% of the upper limit of 41% occurs in APZs and may be impacted by slashing).
- Minor changes to local runoff towards the large dam.
- Subsequent removal of threatened fauna species foraging habitat including mature winter flower resources.
- Removal of a few small hollows.

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into remnant bushland.
- Spill-over effects into surrounding bushland areas, particularly from lights but to a lesser extent from noise.
- Reduced cross-site movements by small bird species such as passerines.
- Concentrated stormwater runoff from solid surfaces and subsequent increased flows.
- Potential loss of connectivity subject to installation of ancillary services.

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

- Increased risk of weed invasion and fungal mobilisation or infections
- Cumulative loss of Lower Hunter Spotted Gum Ironbark Forest EEC
- Cumulative loss of *Rutidosis heterogama*
- Cumulative loss of foraging habitat
- Further fragmentation of local remnants
- Increased varied human presence and activity within the remaining natural habitat areas of the adjacent bushland remnant.

5.4 Mitigation and amelioration of impacts

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

The proposed mitigation measures include revegetation of some 9.8ha of EEC revegetation works and another 12.3ha of enrichment planting works within existing Spotted Gum plantations. This will result in an effective increase the area of the EEC onsite and enrich the quality of habitat within existing revegetation areas.

5.4.1 Vegetation mitigation measures

- A VMP is being prepared to define immediate vegetation clearance and restoration works and to establish a long-term management approach remnant vegetation and habitats within the site, including threatened flora species management, Squirrel Glider habitat enhancement, connectivity improvement, bush regeneration and revegetation. Soil translocation and revegetation of *Rutidosis heterogama* is to be undertaken as part of the VMP works.

- The extent of APZs shall be clearly defined on-ground and there is to be no further encroachment into remnant bushland areas as defined by an 88 B instrument.

- Construction activities will be monitored on-site and monitored by a project ecologist to ensure that the recommendations and conditions of consent are implemented to in accordance with performance targets of the VMP and recommendations of the flora and fauna assessment report.

- All staff involved with the development shall undergo an induction and training program to reinforce the ecological and environmental objectives of the development.

- Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal herbicides.

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

- 15- 20% of understorey by cover (shrub layer) vegetation is to be retained or restored within APZs.

- The *Rutidosis heterogama* population where not affected by APZs should be fenced to limit grazing by animals and slashing activities. Currently these activities mean the plants have limited capacity to flower, be pollinated and set seed and slashing operations are to be timed to allow. Further restoration measures are to be implemented as part of the vegetation management plan in accordance with the 'Approved Conservation Advice (s266B of the Environment Protection and Biodiversity Conservation Act 1999 for *Rutidosis heterogama* (Heath Wrinklewren),

Reference - *http://www.environment.gov.au/biodiversity/threatened/species/pubs/13132-conservation-advice.pdf).*

- Target weed control is to be undertaken within remnant bushland areas to target noxious and environmental weeds.

- Where revegetation works are undertaken, unless on the floodplain, species from the final determinations of the EEC Lower Hunter Spotted Gum Ironbark Forest are to be installed.

5.4.1 Fauna & habitat mitigation measures

- Habitat tree HT5 is to be retained within the Asset protection zone unless it is dangerous and required removal.

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

- Subsequent hollows of retention value are to be relocated to nearby retained vegetation areas. If these are placed as on ground habitat and are not reattached to a new recipient tree then they are to be replaced with appropriately sized nest boxes. Every third box should be a design suitable for microbat species or Squirrel Glider. Boxes should be constructed all of weatherproof timber (marine ply), fasteners and external paint and appropriately affixed to a recipient tree under the guidance of a fauna ecologist.

- If a threatened species is found to be occupying the hollow then the hollow section is to be reattached to a recipient tree within the nearby conservation areas as selected and directed by the fauna ecologist. The welfare and temporary holding of the residing animal(s) is at the discretion of the fauna ecologist. The hollow section should be well secured in the recipient tree in a manner that will not compromise the current or future health of that tree.

- Habitat enhancement works are to be planned and implemented as part of the vegetation management plan to ensure retained areas are improved and appropriately managed for fauna. Priorities for habitat retention include:

    1. Squirrel Glider - planting of foraging species and installtion of nest boxes,
    2. Grey-crowned Babbler - on ground placement and retention of deadwood and restoration of shrub layers (where permissible),
    3. Hollow-dependent microchiropteran bats - relocation of hollows recovered from the development area and construction of bat boxes,
    4. Little Lorikeet - replanting of seasonal foraging resources,
    5. Swift Parrot - replanting of winter flowering resources.

  In respect to Squirrel Gliders enhancement of the existing the plantation/ revegetation areas to potentially support further family groups. Nest boxes are to be placed within the plantation area. These areas are also to be supplemented with more diverse foraging shrubs (including but not limited to banksias and acacias).

Tree plantings are to be undertaken and located to increase local gliding connectivity; these should be represented by local native trees that provide various year-round nectar foraging opportunities. The locations of these plantings should be prioritised to consider re-connecting existing habitat areas (Figure 4). Plantings along the south-eastern site boundary to the patch would be highly beneficial.

- Dead wood lying within the development areas and APZ should be placed into the adjacent forest on site to maintain foraging habitat for Grey-crowned Babblers and other woodland birds.

- If any fauna species, a nest or roost is located during development works, then works should cease until safe relocation can be advised by a contact fauna ecologist. This has low potential to include emerging microbats during the relocation of demountable buildings. This may require a cease work until the colony can be effectively recovered and identified.

- The small dam located within the proposed 320 bed facility area of the subject site should be subject to a dewatering process under the guidance of a fauna ecologist to effectively recover any residing aquatic species, eg turtles, eels and frogs. A dewatering protocol is to be prepared by a project ecologist and followed by the contractors undertaking the dewatering and filling of the dam.

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Fauna Survey Methodologies

A1

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

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

1 Standard survey techniques

1.1 Diurnal birds

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

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

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

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

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

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

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 Elliott 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 Elliott trapping and hair tubing are typically incorporated into terrestrial trapping and hair tubing effort, unless where target survey is undertaken. Standard baiting and layout is therefore described in Section A1.3.2 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.

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

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

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

Where habitat is suitable, the presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for five minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

1.3.1 Koala survey

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

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

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

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

For large sites, Koala search quadrats may be employed within portions of communities where feed trees are present at suitable densities. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw 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 Elliott traps and hair tubes are placed in grids, or more commonly along trap-lines of 5-10 traps separated by distances of 20-50m, depending on site size and variation of habitat. Trap or hair tube sizes selected at each trap station may alternate or may have an emphasis on certain sizes according to target species.

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

Standard bait mix for all Elliott traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat 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 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 waters edge.

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

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

1.6 Amphibians

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

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

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* 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, search quadrats are undertaken evenly across highest quality habitat areas to estimate population size.

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

2 Habitat trees

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

3 Survey effort table descriptors:

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

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

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

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

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

Call-playback - This involves broadcasting 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.

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

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

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

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

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

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

Passive 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 provided from the only known supplier in Poland.

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

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

Threatened & Migratory Species Habitat Assessment

A2

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

Table A2.1 – Threatened flora habitat assessment

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded onsite**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Acacia bynoeana 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	marginal	3 in 10km, 10km away is the nearest	✓	low	✓
Allocasuarina glareicola EPBC	E1	E	Small shrub 1-2m high growing in open sclerophyll forest on lateritic soils derived from tertiary alluviums. Distribution limits Castlereagh NR region.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded onsite**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Angophora inopina EPBC	V	V	Small tree in open sclerophyll forest growing on deep sandy soils with associated lateritic outcrops. Distribution limits N-Wyee S-Gorokan with a disjunct population near Karuah.	x	x	-	-	x	x
Callistemon linearifolius OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S-Georges River.	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
Eucalyptus glaucina OEH EPBC	V	V	Gum to 30m high. Grows in dry open forest and woodlands on clay soils. Distribution limits N-Tweed Heads S-Hunter Valley.	x	marginal	>60 records within 10km. Nearest is 3.5km away	✓	low	✓
Eucalyptus largeana OEH	E1	-	Tree to 40m tall, in wet forest in subtropical ranges. Gloucester to Craven, and Polkolbin.	x	x	-	-	x	x
Eucalyptus parramattensis subsp. *decadens* OEH EPBC	V	V	Red gum to 15m high. Grows in dry open forest on sandy to clay soils often in lowly elevated moist sites. Distribution limits N-Port Macquarie S-Kurri Kurri.	x	x	-	-	x	x
Eucalyptus pumila OEH EPBC	V	V	Mallee species only known from Pokolbin State Forest.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded onsite**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Euphrasia arguta EPBC	E4a	CE	An annual herb to 35cm tall, flowers October to January. Grows in grassy areas near rivers. Recorded from Bathurst to Walcha area. Considered extinct until recent rediscovery in 2008 near Nundle.	x	x	-	-	x	x
Grevillea parviflora subsp. *parviflora* OEH EPBC	V	V	Open to erect shrub to 1m. Grows in woodland on light clayey soils Distribution limits N-Cessnock S-Appin.	x	✓	✓	✓	✓	✓
Melaleuca groveana OEH	V	-	Shrub or tree 2-5, rarely 10m high. Grows in heath, often on exposed sites. Distribution limits N-Werrikimbee NP S-Yengo NP.	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 pauciflora OEH	E4a	CE	A shrub of dry open forest or woodland dominated by *Corymbia maculata*, *Eucalyptus fibrosa* and/or *E. crebra*. Only known from North Rothbury.	x	x	-	-	x	x
Prostanthera cineolifera OEH EPBC	E1	E	Erect shrub to 4m high. Grows in woodland on sandstone ridges, usually in skeletal soils. Known populations nearby to Walcha, Scone and St Albans.	x	x	-	-	x	x
Pterostylis gibbosa EPBC	E1	E	Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**Growth form and habitat requirements**	**Recorded on site (✓)**	**If not recorded onsite**				**Considered in 7 part test of significance (✓) Refer to Appendix 3**
					Suitable habitat present (✓)	**Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Rutidosis heterogama OEH EPBC	V	V	Erect herb to 30cm. Grows mostly in heath, often along roadsides. Distribution limits N-Maclean S-Hunter Valley.	✓	✓	✓	✓	✓	✓
Tetratheca juncea OEH	V	V	Prostrate shrub to 1m high. Dry sclerophyll forest and heath. Distribution limits N-Bulahdelah S-Port Jackson.	x	x	-	-	x	x
Thesium australe EPBC	V	V	Erect herb to 0.4m high. Root parasite. Themeda grassland or woodland often damp. Distribution limits N-Tweed Heads S-south of Eden.	x	marginal	x	x	unlikely	x
Zannichellia palustris OEH	E1	-	Submerged herb. Fresh or slightly saline stationary or slow-flowing water. Distribution limits N-Tweed Heads S-Newcastle.	x	x	-	-	x	x

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

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

Table A2.2 – Threatened fauna habitat assessment

COMMON NAME ***Scientific Name*** DATABASE SOURCE	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT** ***Distribution Limit***	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Stuttering Frog *Mixophyes balbus* EPBC	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. *Distribution Limit: N-near Tenterfield S-South of Bombala*.	×	×	-	-	×	×
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.*	×	✓	×	×	unlikely	✓
Littlejohn's Tree Frog *Litoria littlejohnii* EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. *Distribution Limit: N-Hunter River S-Eden.*	×	×	-	-	×	×
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.*	×	×	-	-	×	×

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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
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.*	×	✓	×	×	unlikely	✓
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.*	×	✓	×	×	unlikely	✓
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.*	×	✓	×	✓	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 and brackish streams and ponds, sheltered mudflats and oyster slats. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	unlikely	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Black-breasted Buzzard *Hamirostra melanosternon* OEH	V	-	Utilises variety of open habitats from riverine and tropical eucalypt woodlands to shrub steppes, arid scrubs, grassy plains and sandy deserts. *Distribution Limit: N-Hungerford. S-Robinvale.*	×	✓	×	×	Not likely	×
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	✓
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.*	×	✓	×	✓	✓	✓
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.*	×	✓	✓	×	✓	✓
Black Falcon *Falco subniger* OEH	V	-	Inhabits plains, grasslands, foothills, timbered watercourses, wetland environs, crops; occasionally over towns and cities. *N-Tweed Heads. S-South of Eden*	×	✓	×	×	Not likely	×

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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Comb-crested Jacana *Irediparra gallinacean* TBE	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	✓
Australian Painted Snipe *Rostratula australis* EPBC	E	E	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	Not likely	×
Gang-gang Cockatoo *Callocephalon fimbriatum* OEH	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. *Distribution Limit: mid north coast of NSW to western Victoria.*	×	✓	×	×	unlikely	✓
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.*	×	✓	×	×	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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Little Lorikeet *Glossopsitta pusilla* OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution Limit: N-Tweed Heads. S-South of Eden*.	×	✓	✓	✓	✓	✓
Swift Parrot *Lathamus discolour* OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution Limit: N-Border Ranges National Park. S-South of Eden*.	×	✓	×	✓	✓	✓
Turquoise Parrot *Neophema pulchella* OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. *Distribution Limit: N-Near Tenterfield. S-South of Eden.*	×	✓	×	×	Not likely	×
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.*	×	✓	×	×	unlikely	✓
Powerful Owl *Ninox strenua* OEH	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	×	✓	×	✓	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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Masked Owl *Tyto novaehollandiae* TBE	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.*	×	✓	×	×	unlikely	✓
Sooty Owl *Tyto tenebricosa* OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	×	-	-	×	×
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.*	×	×	-	-	×	×
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.*	×	✓	×	✓	✓	✓

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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	
Regent Honeyeater *Xanthomyza Phrygia* OEH EPBC	E4A	CE	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution Limit: N-Urbanville. S-Eden.*	×	✓	×	✓	✓	✓
White-fronted Chat *Epithianura albifrons* OEH	V	-	Found in open damp ground, grass clumps, fencelines, heath, samphire saltmarshes, mangroves, dunes, saltbush plains. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	Not likely	×
Painted Honeyeater *Grantiella picta* EPBC	V	V	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. *Distribution Limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.*	×	✓	×	×	Not likely	×
Black-chinned Honeyeater *Melithreptus gularis gularis* OEH	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. *Distribution Limit: N-Cape York Pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.*	×	✓	×	✓	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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Grey-crowned Babbler *Pomatostoomus temporalis temporalis* OEH	V	-	Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Dividing Range except Hunter Valley. *Distribution Limit: N-Qld widespread. S-Mornington Pen. E-se SA.*	✓	-	-	-	-	✓
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*.	×	✓	✓	✓	✓	✓
Hooded Robin *Melanodryas cucullata cucullata* OEH	V	-	Found in Eucalypt woodlands, *Acacia* scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. *Distribution Limit: N-Central Qld. S-Spencer Gulf SA.*	×	✓	×	×	unlikely	✓
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	✓

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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Flame Robin *Petroica phoenicea* OEH	V	-	Summer: forests, woodlands, scrubs, from sea-level to *c.* 1800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. *Distribution Limit: N northern NSW tablelands. S-South of Eden.*	×	✓	×	×	unlikely	✓
Diamond Firetail *Stagonopleura guttata* OEH	V	-	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *Distribution Limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.*	×	✓	×	×	Not likely	×
Spotted-tailed Quoll *Dasyurus maculatus* OEH EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. *Distribution Limit: N-Mt Warning National Park. S-South of Eden.*	×	×	-	-	×	×
Koala *Phascolarctos cinereus* OEH EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×

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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Yellow-bellied 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*.	×	✓	×	✓	Not likely	×
Squirrel Glider *Petaurus norfolcensis* OEH	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. *Distribution Limit: N-Tweed Heads. S-Albury*.	✓	-	-	-	-	✓
Greater Glider *Petauroides volans* EPBC	-	V	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Population density is optimal at elevation levels at 845 m above sea level. Prefer overstorey basal areas in old-growth tree stands. Highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows *Distribution Limit: N-Border Ranges National Park. S- South of Eden.*	×	✓	×	×	Not likely	×
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.*	×	✓	×	×	Not likely	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Brush-tailed Rock-wallaby *Petrogale penicillata* EPBC TBE	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.*	✓	-	-	-	-	✓
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* OEH	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution Limit: N-North of Walgett. S-Sydney.*	×	✓	×	✓	low	✓
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.*	✓	-	-	-	-	✓

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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Large-eared Pied Bat *Chalinolobus dwyeri* OEH EPBC	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. *Distribution Limit: N-Border Ranges National Park. S-Wollongong.*	×	✓	×	✓	low	✓
Eastern Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	✓	-	-	-	-	✓
Little Bentwing-bat *Miniopterus australis* OEH	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution Limit: N-Border Ranges National Park. S-Sydney.*	✓	-	-	-	-	✓
Eastern Bentwing-bat *Miniopterus orianae oceansis* OEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	✓	-	-	-	-	✓
Large-footed Myotis *Myotis macropus* OEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limits: N-Border Ranges National Park. S-South of Eden.*	✓	-	-	-	-	✓

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 (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Greater 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.*	✓	-	-	-	-	✓
Eastern Cave Bat *Vespadelus troughtoni* OEH	V	-	Inhabits drier open forests and woodlands. Roosts in well-lit parts of caves and mineshafts. *Distribution Limit: Along GDR from N-Tweed Heads. S-Sydney.*	✓	-	-	-	-	✓
New Holland Mouse *Pseudomys novaehollandiae* OEH EPBC	-	V	Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1m high and sparse ground litter. Recolonise of regenerating burnt areas. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	×	-	-	×	×
Hastings River Mouse *Pseudomys orialis* EPBC	E	E	Found at mid to high altitudes (to 1200m), mostly in damp, dense fern or sedge understorey along drainage lines, but also utilises drier areas with grassy or heathy groundcover. *Distribution Limit: N-Lamington Qld. S-Barrington Tops.*	×	×	-	-	×	×
OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife*								

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 (✓) (Refer to Appendix 3)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	

EPBC	-	Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
TBE	-	Denotes additional species considered by *Travers bushfire & ecology* to have potential habitat based on regional knowledge and other records
V	-	Denotes vulnerable listed species under the relevant Act
E	-	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*
	3.	'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle

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

Table A2.3 – Migratory fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT** ***Migratory Breeding***	**Suitable Habitat Present (✓)**	**Recorded on Site (✓)**	**COMMENTS**
Oriental or Horsfield's Cuckoo (*Cuculus optatus*)	It mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	✓	×	-
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. *Sedentary; dispersive.*	✓	×	-
White-throated Needletail (*Hirundapus caudacutus*)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. *Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.*	✓	×	-
Rainbow Bee-eater (*Merops ornatus*)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. *Breeding resident in northern Australia. Summer breeding migrant to south east and south west Australia.*	✓	×	-
Spectacled Monarch (*Monarcha trivirgatus*)	Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. *Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept/Oct to May. Uncommon in southern part of range.*	×	-	-
Black-faced Monarch (*Monarcha melanopsis*)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. *Summer breeding migrant to coastal south east Australia, otherwise uncommon*.	×	-	-
Yellow Wagtail (*Motacilla flava*)	The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops.	✓	×	-
Satin Flycatcher (*Myiagra cyanoleuca*)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.*	✓	×	-

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
Rufous Fantail (*Rhipidura rufifrons*)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. *Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.*	✓	×	-
Great Egret (*Ardea alba*)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. *Dispersive; cosmopolitan.*	✓	✓	One Great Egret was observed foraging along the edges of the large dam during survey. The proposed development area is not likely to remove any important habitat for this species. Therefore no significant impact is likely to occur.
Cattle Egret (*Ardea ibis*)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. *Breeds in summer in warmer parts of range including NSW*.	✓	×	-
Latham's Snipe (*Gallinago hardwickii*)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.*	✓	×	-
Bar-tailed Godwit (*Limosa lapponica*)	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh.	×	-	-

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
Common Greenshank (*Tringa nebularia*)	Found in a wide variety of inland wetlands and sheltered coastal habitats (with large mudflats and saltmarsh, mangroves or seagrass) of varying salinity, Habitats include embayments, harbours, river estuaries, deltas and lagoons. It uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. Also artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. In NSW the Hunter River estuary has been identified as a site of international importance. *Breeds in Eurasia, the northern British Isles, Scandanavia, east Estonia and north-east Belarus, through Russia and east.*	×	-	-
Little Curlew (*Numenius minutus*)	Feeds in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used. When resting, congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. Prefers pools with bare dry mud and they do not use pools if they are totally dry, flooded or heavily vegetated. *Breeds in Russia.*	✓	×	-
Osprey (*Pandion haliaetus*)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. Feeds on fish over clear, open water. Breeds from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometer of the sea.	×	-	-
Fork-tailed Swift (*Apus pacificus*)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. *Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.*	✓	×	-

7 Part Test of Significance

A3

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

The following 7 part test of significance relies on the ecological assessment provided in Sections 3 and 4 of this report and should be read as such.

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

Threatened flora

Scientific name	*TSC Act*	Potential to occur	Potential impact
Acacia bynoeana	E1	low	Direct – removal or modification of potential habitat only
Callistemon linearifolius	V	✓	Direct – removal or modification of potential habitat only
Eucalyptus glaucina	V	low	Direct – removal or modification of potential habitat only
Grevillea parviflora subsp. *parviflora*	V	✓	Direct – removal or modification of potential habitat only
Rutidosis heterogama	V	recorded	Direct – potential to impact upon up to 41% of the population

Threatened fauna

Common name	TSC Act	Potential to occur	Potential impact
Grey-crowned Babbler	V	recorded	Direct - removal of foraging / roosting habitat
Squirrel Glider	V	recorded	Direct - removal of foraging habitat.
Grey-headed Flying-fox	V	recorded	Direct - removal of foraging habitat
East-coast Freetail Bat	V	recorded	Indirect - removal of foraging habitat. Unlikely removal of roosting / breeding habitat
Eastern Falsistrelle	V	recorded	Indirect - removal of foraging habitat.
Little Bentwing-bat	V	recorded	Indirect - removal of foraging habitat.
Eastern Bentwing-bat	V	recorded	Indirect - removal of foraging habitat.
Large-footed Myotis	V	recorded	Direct - unlikely removal of roosting / breeding habitat
Greater Broad-nosed Bat	V	recorded	Indirect - removal of foraging habitat. Unlikely removal of roosting / breeding habitat
Eastern Cave Bat	V	recorded	Indirect - removal of foraging habitat.
Little Eagle	V	✓	Direct - removal of potential foraging habitat.
Square-tailed Kite	V	✓	Direct - removal of potential foraging habitat.
Little Lorikeet	V	✓	Direct - removal of potential foraging habitat. Unlikely removal of roosting / breeding habitat

Common name	TSC Act	Potential to occur	Potential impact
Swift Parrot	E	✓	Direct - removal of potential foraging habitat.
Brown Treecreeper	V	✓	Direct - removal of potential foraging/roosting/breeding habitat.
Speckled Warbler	V	✓	Direct - removal of potential foraging habitat.
Regent Honeyeater	E4A	✓	Direct - removal of potential foraging habitat.
Varied Sittella	V	✓	Direct - removal of potential foraging/roosting/breeding habitat.
Australasian Bittern	E	low	Direct - removal of low potential foraging habitat.
Spotted Harrier	V	low	Direct - removal of low potential foraging habitat.
Comb-crested Jacana	V	low	Direct - removal of low potential foraging habitat.
Powerful Owl	V	low	Direct - removal of low potential foraging/roosting/breeding habitat.
Black-chinned Honeyeater	V	low	Direct - removal of low potential foraging/roosting/breeding habitat.
Yellow-bellied Sheathtail-bat	V	low	Indirect - removal of low potential foraging habitat.
Large-eared Pied Bat	V	low	Indirect - removal of low potential foraging habitat.
Green and Golden Bell Frog	E	unlikely	Indirect - removal of unlikely potential shelter habitat.
Freckled Duck	V	unlikely	Indirect - removal of unlikely potential adjacent habitat.
Black-necked Stork	E	unlikely	Indirect - removal of unlikely potential adjacent habitat.
Black Bittern	V	unlikely	Indirect - removal of unlikely potential adjacent habitat.
Gang-gang Cockatoo	V	unlikely	Indirect - removal of unlikely potential foraging habitat.
Glossy Black-Cockatoo	V	unlikely	Indirect - removal of unlikely potential foraging habitat.
Barking Owl	V	unlikely	Indirect - removal of unlikely potential foraging habitat.
Masked Owl	V	unlikely	Indirect - removal of unlikely potential foraging habitat.
Hooded Robin	V	unlikely	Indirect - removal of unlikely potential foraging habitat.
Flame Robin	V	unlikely	Indirect - removal of unlikely potential foraging habitat.

Endangered populations

- None for fauna
- *Cymbidium canaliculatum* population in the Hunter Catchment

Endangered ecological communities

- Lower Hunter Spotted Gum Ironbark Forest
- Swamp Oak Floodplain Forest

The 7 part test of significance is as follows:

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

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

- Removal/modification of 6.8 ha of EEC, Lower Hunter Spotted Gum Ironbark Forest.
- APZ impacts of 0.53 ha of Spotted Gum Plantation for the 320 bed build.
- Possible loss of small dam near north-west corner of the 320 bed build.
- Loss of up to 41% of the *Rutidosis heterogama* population by the 400 bed build (~10% of the upper limit of 41% occurs in APZs and may be impacted by slashing).
- Minor changes to local runoff towards the large dam.
- Subsequent removal of threatened fauna species foraging habitat including mature winter flower resources.
- Removal of a few small hollows.

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into remnant bushland.
- Spill-over effects into surrounding bushland areas, particularly from lights but to a lesser extent from noise.
- Reduced cross-site movements by small bird species such as passerines.
- Concentrated stormwater runoff from solid surfaces and subsequent increased flows.
- Potential loss of connectivity subject to installation of ancillary services.

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

Summary of threatened species recorded

Rutidosis heterogama

Rutidosis heterogama is a perennial herb that grows to 30cm in height. It grows in heath, often along disturbed roadsides, mainly in coastal districts from Maclean to the Hunter Valley, and inland to Torrington (Harden 1992).

Pollinators are native bees and other insects; during the field survey native bees, moths, flies and beetles were observed on flowers. Rutidosis are genetically self-incompatible. However it has been shown that in small populations (<200 individuals) self-incompatibility can break down with consequential inbreeding potentially leading to local extinction.

The pappus (structures at the top of Asteraceae seed to aid in wind dispersal) on Rutidosis seed is in the form of rudimentary scales and seed are dispersed within a short distance (0.5 m of the plant) and generally germinate within that area. Seed are only viable in soil for about four months.

Thus, identifying the full extent of a population is difficult and may be restricted to a few hundred metres or as far as the pollinators would likely fly.

The 400 bed rapid build, associated cut and fill and APZs will impact up to 41% of the estimated population, approximately 10% of which is within an APZ and may not be impacted very much or at all.

The current regime across the area where these occur within the study area is that the vegetation is slashed and grazed. These factors reduce the potential for the population to flower, be pollinated and set seed.

Whilst the proposal will place pressures upon the population, it is spread over 14 ha, of which 11.1 ha will remain unaffected by the proposal. The population is however concentrated in a smaller area.

The distribution of the species is largely coastal NSW from the Central Coast near Wyong to northern NSW and inland to Howes Valley and Torrington. The larger populations are

centred upon the Hunter Valley, particularly close to Kurri Kurri as well as the Maclean Valley. The location of the specimens potentially impacted are not at their limits of distribution.

The action occurs on one side of the population rather than crossing the full extent and does not completely surround the area of occupation. As such, the action will not fragment the population into two or more populations.

The development will not disrupt the breeding cycle. It is proposed that where the individuals occur outside of the impact area, these will no longer be slashed, instead be conserved with appropriate management to assist them flowering, being pollinated and setting seed.

The proposal will see a reduction on population area, however there will be future opportunities for the specimens to re-expand a little to the north.

The proposal is unlikely to see any significant weed incursions entering the area of the *Rutidosis heterogama* and unlikely to introduce *Phytophthora* or Myrtle Rust to the site that could impact upon the population.

Therefore, despite a large impact upon the species, many specimens still remain and the area of the known habitat will be reduced by only 20%. As such, the proposal is unlikely to have a detrimental impact upon the life cycle of the species where it would be placed at risk of local extinction.

Squirrel Glider (*Petaurus norfolcensis*)

Squirrel Gliders inhabit mixed aged stands of eucalypt forest & woodlands including gum barked and high nectar producing species with hollow bearing trees. Its diet varies seasonally and consists of acacia and eucalypt sap, nectar, pollen, flowers, plant exudates caterpillars, beetles and other invertebrates (Menkhorst & Collier 1987). It forages at a variety of heights, from the crowns to shrubby understory. It is a sure-footed and agile climber, and can glide as far as 50 metres between trees.

Habitat requirements are stricter than those of the Sugar Glider: Squirrel Gliders need a mix of eucalypts and acacias, and also favour banksias. At least one favoured tree species must flower in winter and one or more of the eucalypts needs to be smooth-barked, both to provide a greater variety of insect food and because smooth-barked eucalypts tend to harbour more hollows.

Squirrel Gliders live in family groups of 2 to as many as 10 individuals, but typically comprising an adult male, one or more adult females, and their offspring of the season. Breeding can take place at any time of year but depends on food availability. Females can have two litters a year in good conditions, more commonly one. The young leave the nest at around 6 months but despite aggression from the dominant male may remain in the general area for about another year before finding a territory of their own. Mortality during the dispersion phase is high but once established, individuals can survive for up to six years,

According to Quin (1995) the home-ranges of Squirrel Gliders have been estimated at between 0.65 and 8.55 ha, the movement of males being greater than that of females. Nightly movements are estimated at between 300 and 500 m. Quin (1995) found that the home-range of a family group is likely to vary according to habitat quality and availability of resources. The presence of mature, hollow-bearing eucalypts is a critical characteristic of habitat occupied by Squirrel Gliders as they are utilised for nesting and breeding (Suckling, 1995).

The Squirrel Glider was recorded during targeted spotlighting at five locations within the study area and nearby surrounds. At one location two Gliders were observed. Based on the distance and timing between observations it is considered that these gliders were of possibly three or more likely four separate family groups.

Spotted Gum trees represent one of three potential winter flowering myrtaceous trees in the local landscape which is an important habitat requirement for Squirrel Gliders. Initial field assessments revealed that the south-western portion of the subject site for the proposed 400 bed facility was potentially impacting mature Spotted Gum and Ironbark trees within the landscape. Further habitat assessment revealed that mature Spotted Gum trees are not otherwise well represented elsewhere in the nearby locality (refer to the Squirrel Glider habitat assessment on Figure 5). Having said this Spotted Gums area very well represented within the two large plantation areas within the study area, albeit maturing specimens. Elsewhere within the local surrounding landscape other trees species dominate the foraging landscape.

This observation, combined with the recorded presence of *Rutidosis heterogama* throughout this same subject site area prompted a review of the proposed footprint. Subsequent to this the footprint for the 400 bed facility has been moved 110m east and 40m north primarily to retain *Rutidosis heterogama.* This in turn has maintained sufficient mature Spotted Gum trees in this location to conclude that the proposed development will not likely significantly impact on the local Squirrel Glider population.

The habitat assessment for Squirrel Glider did bring to light that the local population, whilst represented by a number of nearby family groups, is clinging onto available habitat opportunities and is at high risk of potential isolation and loss of foraging resources due to works within the correctional facility. Indeed there is a lower density of hollows throughout the local landscape to ideally support a healthy Squirrel Glider population. Recent Squirrel Glider habitat removal to the south is also known to have removed a den tree from anecdotal information.

The local connectivity is becoming increasingly fragmented and several locations exist where it is apparent that gliders can only make passage by along the ground movements. This is evident in the north-eastern corner of the golf course where one glider was observed. Some nest boxes are present in this relatively small patch however there is no gliding connectivity in or out.

Based on these findings it is possible that the EEC habitat removed by the proposed facilities can be beneficially offset providing revegetation areas for future gliding connectivity between foraging areas and further enhanced by the installation of nest boxes within the same foraging areas. Squirrel Gliders readily take to nest boxes and they would be an ideal additional to the existing plantation areas which have increasingly valuable foraging habitat with no denning opportunities. The plantation areas if also supplemented with more diverse foraging shrubs (banksias and acacias) may support further family groups and improve the long term survival of the local population.

Where plantings are placed to increase local connectivity, these should be represented by local native trees that provide various year-round nectar foraging opportunities. Plantings along the south-eastern site boundary to the patch within the north-east of the golf course (described above) would be highly beneficial.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis)*

The Grey-crowned Babbler occupies open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact groundcover of grass and forbs. This species

forages in leaf litter and on the bark of trees (Garnett & Crowley 2000). Birds forage in a group, usually staying within fifteen metres of each other, but occasionally spreading out to thirty metres. (Boles 1988). All members of a group cooperate in (nest) building and caring of the young but only the breeding female incubates and broods. (King.1980). The whole group roosts each night in a dormitory nest. Many of these dormitory nests are built and maintained throughout the year. (Schodde & Tidemann 1988).

Grey-crowned Babblers (6) were observed within the northern vegetation patch. Two roosting platforms were also located within this area close to where the birds were seen. Grey-crowned Babblers have also been recorded during previous surveys within the study area and local surrounds. All vegetation communities provide suitable habitat for this species, particularly mature growth areas where a greater abundance of terrestrial deadwood logs and litter provide enhance foraging opportunity. No roosting platforms were observed outside the northern vegetation patch. A fox kill of a bird was also identified with feathers similar to Grey-crowned Babbler.

The Grey-crowned Babbler may utilise the habitat proposed for removal, particularly the small northern patch proposed for the 320 bed facility close to the recorded location. Despite this, none of the proposed development areas are of likely high value habitat areas of core activity or utilised for breeding based on survey observations. Given this, the small habitat areas removed and consideration to other nearby local records indicating other family parties, the proposed development is not likely to significantly impact on the local Grey-crowned Babbler population.

It is however recommended that habitat planting and restoration measures would provide long-term benefit for the Grey-crowned Babbler. Deadwood habitat removed from proposed development areas should also be relocated into the plantation areas where this habitat feature is somewhat deficient, in order to enhance potential for foraging use of these areas.

Grey-headed Flying-fox *(Pteropus poliocephalus)*

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

Camps are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy (Tidemann 1998). Camps can be found in riparian rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas. Loyalty to a site is high and some camps in NSW have been used for over a century (NSW NPWS 2001). Some camps are used at the same time every year by hundreds of thousands of flying-foxes while others are used sporadically by a few hundred individuals (Strahan 1995). Generally foraging is within 20km of camps but individuals are known to commute up to 50km to a productive food source.

An individual Grey-headed Flying-fox was recorded foraging on flowering Spotted Gum at two separate locations within the subject site during recent 2016 winter survey. There is no likelihood of this species utilising the subject site for roosting and subsequent breeding habitat. Mature foraging trees utilised for seasonal foraging will be removed as part of the proposal.

Foraging habitat is otherwise well represented in the surrounding locality such that removal of habitat will not significantly impact on a local population. It is recommended that foraging habitat is replaced by locally native flowering eucalypts within landscaping areas.

Eastern Bentwing-bat *(Miniopterus orianae oceanensis),* Little Bentwing-bat *(Miniopterus australis)* and Eastern Cave Bat *(Vespadelus troughtoni)*

These three microbat species are considered here together based on their similar habitat requirements and subsequent impacts from the proposal.

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.

The Eastern Bentwing-bat has not been identified as utilising culverts for maternity roosts. Maternity roosts rather are occupied by up to 100 000 females with only 12 maternity roosts known throughout the complete range (Hoy & Hall 2008).

The Little Bentwing-bat forages below the canopy within open forests and woodlands, feeding on small insects (Dwyer 1995b). This species roosts in caves, tunnels, tree hollows and occasionally old buildings (Dwyer 1995b). 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 1995b). One record exists of this species utilising a tree hollow however hollows are not currently considered as preferred habitat for this species (pers. com. Brad Law).

The Eastern Cave Bat is a poorly known species, which apparently is predominantly a cave/overhang dweller but also occurs in buildings. It has been found roosting in small groups in sandstone overhang caves, boulder piles, mine tunnels and occasionally in buildings. These bats roost sites are near the entrance in generally well lit areas. They roost in small avons or domes in the roofs of the caves as well as in cracks or crevices (Churchill 1998). The Eastern Cave Bat inhabits tropical mixed woodland and wet sclerophyll forest on the coast and the dividing range but extends into the drier forests of the western slopes and inland areas (Churchill 1998). It forages mainly beneath the canopy in a range of forest types over its range (SFNSW, 1995).

These three microbat species were all recorded within or close to the south-western subject site. All three species have some potential to be roosting within the demountable buildings to be relocated from the subject site. Such buildings are not likely to support breeding colonies of these species which require ideal temperatures within caves for this part of the life-cycle.

Therefore the proposed removal of artificial habitat for low potential roosting and the removal of vegetated areas for foraging will not likely significantly impact on any of these populations. It is recommended that if any fauna species are recorded, particularly emerging microbat during the habitat removal and demountable relocations then a contact fauna ecologist be immediately engaged to determine best practice measures.

East-coast Freetail-bat (*Micronomus norfolkensis*), Large-footed Myotis (*Myotis macropus*), Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*)

These four microbat species have been considered here together based on their similar habitat requirement only with respect to potential dependence on hollows for roosting and breeding. Such microhabitat characteristics are likely to change according to specific

requirements of each species, for example the Eastern Falsistrelle's preference for large trunk hollows, however the assessment conclusion is consistent for each.

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

The East-coast Freetail Bat is a highly mobile species and local habitat would not be exclusive to the subject site. Hoy et. al (2008) suggest that despite a female recorded 6km from its roost, this species generally forages within a few kilometres of roosts. Cleared and semi-cleared landscapes have been found to have higher activity levels than urban or forested landscapes. Riparian sites are also found to have high activity levels.

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

The Large-footed Myotis 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 Eastern Falsistrelle inhabits warm to cool temperate moist and dry open forests (Strahan 1995) with a preference for wet high altitude forests and being less common on ridge-tops where fertility is low (Law , Herr & Phillips, 2008). It is one of the larger and less common forest bats, with wing morphology indicating it to be a highly mobile species with a large foraging range with recordings up to 12km from roosting sites (Herr, Law & Phillips, 2008) and home ranges up to 136ha (Churchill, 2008).

Flight by the Eastern Falsistrelle is not very manoeuvrable and as such foraging takes places in open stuctures or along trails in forest environs. It hunts beetles but also moths and bugs. The Eastern Falsistrelle roosts mainly in tree hollows, occasionally utilising caves and abandoned buildings (Parnaby 1992; Phillips et al. 1985). Roosts in trees are generally in hollow trunks of eucalypt trees in colonies of 3 to 80 (Churchill 2008). Cave roosting is recorded at Jenolan, NSW, with occasional roosts also recorded in old wooden structures (Churchill, 2008). Colonies are usually entirely male or female for reasons currently unknown.

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

The Greater Broad-nosed Bat feeds on large slow flying beetles and moths (Dwyer 1965; Vestjens and Hall 1977). This species is a slow flier and generally hunts for insects over

understorey vegetation as well as foraging along the interface of clearings and paddocks with forested areas and along tree-lined creeks (Richards 1988).

The Large-footed Myotis and East-coast Freetail Bat were recorded by TBE during recent 2016 survey within the study area. Surveys by *Advitech* (2012) indicated that calls consistent with three species of hollow-roosting threatened microchiropteran bats were recorded within the site, being Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), East Coast Freetail Bat (*Mormopterus norfolkensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

It is considered that the subject site provides suitable foraging habitat for each of these four microbat species. Foraging habitat however does differ significantly for each species, for instance, the Large-footed Myotis has a high dependence on open water foraging areas. Roosting and subsequent breeding in hollows recorded present within the subject site is considered unlikely. This is given that the recorded hollows to be removed are small spout hollow, a trunk base hollow, and nest box (with Common Brushtail Possum recorded within) and otherwise exfoliating bark. Such hollows are not generally typical of these species and therefore it is unlikely that the removal of a relatively small extent of foraging habitat will significantly impact on any of these four microbat species.

Despite this it is recommended that to provide additional assurance of preventing impact, the felling of hollow-bearing trees should be conducted under the supervision of a fauna ecologist to effectively recover residing animals. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse. In the instance of recording the presence of threatened microbats during tree removal, maximum effort should ensure safe relocation of the roosting colony.

Re-used hollows or those with likely occupation are to be relocated to conserved areas within close proximity to the site. All other hollows removed should be replaced with nest boxes. Every second box should be a design suitable for microbat species. Boxes should be constructed all of weatherproof timber (marine ply), fasteners and external paint.

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

There are no endangered fauna populations within the Cessnock LGA.

There is one (1) known endangered population that occurs within the Cessnock LGA.

- *Cymbidium canaliculatum* population in the Hunter Catchment

The population in known to occur within dry sclerophyll forests and woodlands of NSW tablelands and western slopes, growing in the hollows of trees, fissures, trunks and forks. Specimens in the Hunter Catchment are most commonly associated with the tree species, *Eucalyptus albens*.

The study area is sited near the far southern extent of the species' geographic distribution.

Eucalyptus albens is absent however it is known to also grow on *Eucalyptus crebra* which is a dominant canopy species across the study area. There is also only one (1) noted record within a 10km, centred near Pokolbin approximately 6km west north-west. The record is from 1928 and has a 10km accuracy, so could actually be on / adjacent to the site, or as far as 16km away.

Given the above, the study area provides marginal habitat for species of this population to occur. The species was not observed and not likely to be impacted by the proposal.

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

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

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Lower Hunter Spotted Gum Ironbark Forest

This threatened ecological community is listed as endangered under the TSC Act. It is not currently attributed to an EEC under the EPBC Act.

The total amount of this EEC within the study area is estimated at 24.29 ha. It is comprised of three (3) variants based on condition. The potential impact by development and APZs on each is shown below.

Condition	Area of coverage	Area of impact	% impact
Moderate-good, fully structured	13.72 ha	1.21 ha	8.8%
Managed understorey and thinned canopy	9.03 ha	4.05 ha	44.9%
Canopy only with no understorey	1.54 ha	1.54 ha	100.0%
	24.29 ha	**6.80 ha**	**28.0%**

The majority of the impact is upon the poorer condition vegetation for the 280 and 400 bed builds upon vegetation which is presently slashed and continually managed which inhibits natural regeneration.

Approximately 17.5 ha of this EEC will be retained post construction in several patches, which will not become isolated or fragmented, with the exception of one small polygon located on the southern side of the 280 bed build which is already isolated and fragmented.

This EEC is very dominant in the landscape in and surrounding Cessnock above the floodplain of the Hunter River and tributaries. Figure 4 in the body of the report shows one of the broad-scale vegetation maps of the Lower Hunter Central Coast Regional Environmental Management Strategy (sourced from SIXmaps) which may have some inaccuracies, however the olive green colour typically indicated the EEC in the locality. There are possibly more areas between the site and the surrounding bushland to the east and south that form part of the EEC but have not been mapped where they are canopy only within urban landscapes. The figure shows that the EEC occurs on adjoining properties and adds to the argument that the proposal will not isolate/fragment the EEC overall.

Whilst the proposal contributes to a cumulative loss of the EEC, it will not have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Swamp Oak Floodplain Forest

The nearest remnant of this EEC occurs a minimum of 45m from the outer edge of the APZ of the 400 bed rapid build, thus no direct impacts are likely.

Indirect impacts upon this community may be in the form of ongoing access by vehicles, weed invasion, rubbish dumping and changes to local hydrology. These issues are not likely to be exacerbated by the proposal, although hydrological changes are the most likely to potentially occur. These can be easily managed through standard sediment and erosion control practices, and may be further addressed through swale construction or raingardens, provided they are contained within the APZ area.

The proposal is not considered to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

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

Lower Hunter Spotted Gum Ironbark Forest

The composition of a community may be impacted through the removal of a layer of vegetation or via the concentrated removal of selected species that may have a big influence of maintaining the communities' integrity, in particular if a large portion of a remnant is affected.

The proposal will require APZs upon remnant EEC vegetation. The 280 and 400 bed builds will mostly impact upon vegetation that is already compromised and managed in the same form as an APZ, thus unlikely to have much impact. Approximately 1 ha of intact vegetation of nearly 14 ha will be impacted by APZ management. This is only a small proportion of a large remnant and is not expected to adversely modify the composition of this community such that its local occurrence is likely to be placed at risk of extinction.

The proposed mitigation measures include revegetation of some 9.8ha of EEC revegetation works and another 12.3ha of enrichment planting works within existing Spotted Gum plantations. This will result in an effective increase the area of the EEC onsite and enrich the quality of habitat within existing revegetation areas.

Swamp Oak Floodplain Forest

No modification to this EEC is proposed.

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

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Acacia bynoeana, Callistemon linearifolius, Eucalyptus glaucina, Grevillea parviflora* subsp. *parviflora, Rutidosis heterogama,* Lower Hunter Spotted Gum Ironbark Forest*,* Green and Golden Bell Frog, Freckled Duck, Black-necked Stork, Australasian Bittern, Black Bittern, Spotted Harrier, Little Eagle, Square-tailed Kite, Comb-crested Jacana, Gang-gang Cockatoo, Glossy Black-Cockatoo, Little Lorikeet, Swift Parrot, Barking Owl, Powerful Owl, Masked Owl, Brown Treecreeper, Speckled Warbler, Regent Honeyeater, Black-chinned Honeyeater, Grey-crowned Babble, Varied Sittella, Hooded Robin, Scarlet Robin, Flame Robin, Squirrel Glider, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Large-eared Pied Bat, Eastern Falsistrelle, Little Bentwing-bat, Eastern Bentwing-bat, Large-footed Myotis, Greater Broad-nosed Bat and Eastern Cave Bat.

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

The total lot size is approximately 135.5 ha, 84.7 ha is cleared and the remaining 50.8 ha contains remnant vegetation and planted vegetation.

The proposed buildings and APZs will impact upon approximately 6.8 ha of Lower Hunter Spotted Gum Ironbark Forest, 0.53 ha of Spotted Gum plantation and 0.06 ha of a dam with fringing vegetation. The proposed mitigation measures include revegetation of some 9.8ha of EEC revegetation works and another 12.3ha of enrichment planting works within existing Spotted Gum plantations. This will result in an effective increase the area of the EEC onsite and enrich the quality of habitat within existing revegetation areas.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposal will not fragment or isolate areas of habitat for threatened species or EECs. There are no endangered populations requiring consideration. The proposal for the 400 bed build has been modified to reduce impacts upon EECs, threatened flora and the Squirrel Glider. The original position would have seen an impact on over 60% of the Rutidosis population and potentially provided a barrier to Squirrel Glider movement. A corridor has now been retained for the Squirrel Glider and impacts for Rutidosis and the EECs have been reduced such that fragmentation and isolation issues are removed.

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

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

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

The impact upon *Rutidosis heterogama* habitat is important and it also forms EEC vegetation (Lower Hunter Spotted Gum Ironbark Forest). In regards to the survival of the two entities, both are common in the local area, however the Rutidosis is more restricted because the pollinator vectors and spread of seeds is usually over a few hundred metres, thus the population may be considered restricted to the subject site and the adjoining bushland to the immediate south. As discussed under a) of the 7 part test for *Rutidosis heterogama,* habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population and ecological communities in the locality is not considered to be significant.

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

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

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

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

- Barking Owl (*Ninox connivens*) (NPWS 2003)
- Green and Golden Bell Frog (*Litoria aurea*) (DEC 2005)

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

- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*)) (DEC 2006).

Rutidosis heterogama

No recovery plan has been prepared for this species.

The following actions are recommended for the recovery of this species:
(http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10737)

1. Stay on formed tracks when visiting heath areas to avoid trampling plants.
Response: The group of plants retained within the investigation area will be protected from disturbance.
2. Photograph wildflowers instead of picking or collecting them.
Response: The group of plants retained within the investigation area will be protected from future disturbance through delineation from APZs and possibly fenced to limit access.
3. Protect areas of habitat from frequent fire.
Response: A vegetation management plan is in the process of being prepared which addresses this issue.
4. Identify roadside populations and protect during roadside maintenance works.
Response: No roadside populations occur within the investigation area.
5. Protect areas of heath and moist open forest from clearing and development.

Response: Clearing of habitat will be restricted to only that necessary for the project. All other areas of habitat will be protected.

Restoration measures are to be implemented as part of the vegetation management plan in accordance with the *'Approved Conservation Advice (s266B of the Environment Protection and Biodiversity Conservation Act 1999 for* Rutidosis heterogama *(Heath Wrinklewren), Reference* - http://www.environment.gov.au/biodiversity/threatened/species/pubs/13132-conservation-advice.pdf).

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

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

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

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

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

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

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

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

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

Aggressive exclusion of birds by Noisy Miners (Manorina melanocephala)

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

Human-caused Climate Change

The proposal will require the removal of a small amount of vegetation which will result in a negative or positive contribution to climate change. Vegetation is considered to act as a sink for a range of greenhouse gases but in particular Carbon Dioxide. The maintenance of native vegetation cover is a key strategy to combat the contributing impacts of the proposed action on Climate Change. Whilst almost insignificant in size, the proposal is part of the

accumulative effect and thus should be considered as contributing to this threatening process.

Clearing of native vegetation

The proposal is of a class of development recognised as a threatening process. It is generally recommended that all sites should aim to achieve a maintain or improve outcome on the quality and quantity of native vegetation cover through protection and restoration measures. Approximately 7.4 ha of total vegetation will be removed or modified for the proposal. A vegetation management plan is in preparation that will assist in long-term management of the site. It proposes revegetation works that would be equivalent or greater in size to the amount of vegetation being impacted.

The proposed mitigation measures include revegetation of some 9.8ha of EEC revegetation works and another 12.3ha of enrichment planting works within existing Spotted Gum plantations. This will result in an effective increase the area of the EEC onsite and enrich the quality of habitat within existing revegetation areas.

Competition and grazing by the feral European rabbit

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

Infection of native plants by Phytophthora cinnamomi

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

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

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

Invasion of native plant communities by exotic perennial grasses

It is possible that if non-native grasses or lawns are utilised around the new buildings, that they may spread into neighbouring bushland. The use of lawns and fertilisers which adjoin remnant native vegetation should be prohibited.

Loss of hollow-bearing trees

Hollow-bearing tree surveys identified five (5) hollow-bearing trees that will be likely removed within the subject site. One of these was in fact a tree containing a nest box, another was a base cavity and otherwise all other were small (0-5cm) sized branch spout hollows or exfoliating bark. This assessment will assume the removal of all of these trees within the subject site and as such is a class of development recognised as a threatening process.

The nest box may be relocated / replaced and the large tree base hollow is not likely to be utilised in such a disturbed landscape. It is considered unlikely that the hollows to be removed are utilised by threatened species given that spouts and exfoliated bark unlikely contain a large internal cavity. The relocation or replacement of hollows is recommended to supplement the loss of natural hollows.

Removal of dead wood and dead trees

The proposal will require the removal of deadwood and dead trees and as such is a class of development recognised as a threatening process. Threatened fauna species with potential habitat within the subject site and likely dependent on dead wood or dead trees include Green and Golden Bell Frog, Brown Treecreeper, Speckled Warbler, Grey-crowned Babbler, Varied Sittella, Hooded Robin, Scarlet Robin, Flame Robin and Squirrel Glider. Of these species, the Grey-crowned Babbler and the Squirrel Glider were recorded present during surveys.

It is therefore recommended that deadwood and dead trees present within the development areas are relocated where possible to remaining habitat areas within the study area. This ideally should include the plantation areas where deadwood habitat is notably deficient. Such habitat removal and enhancement measure should be undertaken under the guidance of a fauna ecologist and as directed under a Habitat Management Plan or Vegetation Management Plan. A detailed effort to relocate deadwood would improve habitat quality within the plantation areas and be an adequate offset to deadwood habitat loss for these species.

National - Significant Impact Criteria

A4

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

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

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

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

>> What is a population of a species?

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

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

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

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

VULNERABLE SPECIES

Significant impact criteria

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

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

>> What is an important population of a species?

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

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

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

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

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

MIGRATORY SPECIES

Significant impact criteria

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

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

>> What is important habitat for a migratory species?

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

>> What is an ecologically significant proportion?

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

>> What is the population of a migratory species?

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