

EIGHT PART TEST

over land proposed for
residential development

at

**LOT 101
4 BRUNKER ROAD
ADAMSTOWN**

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1.0 INTRODUCTION

It is proposed that Defence Housing and associated infrastructure be constructed on Lot 101, 4 Brunner Road, Adamstown (Figure 1). This report is intended to indicate the likelihood of the proposed development having a significant effect on the habitat of threatened species of flora and fauna, and to fulfil other requirements of the Environmental Planning and Assessment Act (EPA Act) 1979 and the Threatened Species Conservation Act (TSC Act) 1995.

1.1 GENERAL DESCRIPTION OF THE SITE

The site is 5.252 hectares in area and is bounded by Brunner Road to the west, residential dwellings to the east, St Colomus Primary School to the north, a Golf Course to the south-east and an Army Training Depot to the south (Figure 2). The site was previously used as an Army Reserve Training Area.

The site has been previously cleared and occupied as evidenced by a number of old concrete slabs and drains scattered across the site, particularly in the northern and western portions. A sealed road traverses the site from the west to the north. Small isolated patches of native vegetation were identified within the northern portion of the site and sparsely scattered across the cleared areas of grassland. These areas of vegetation, particularly within the northern portion of the site show signs of planting for landscape purposes and also include exotic species commonly identified in gardens.

1.2 DESCRIPTION OF THE PROPOSAL

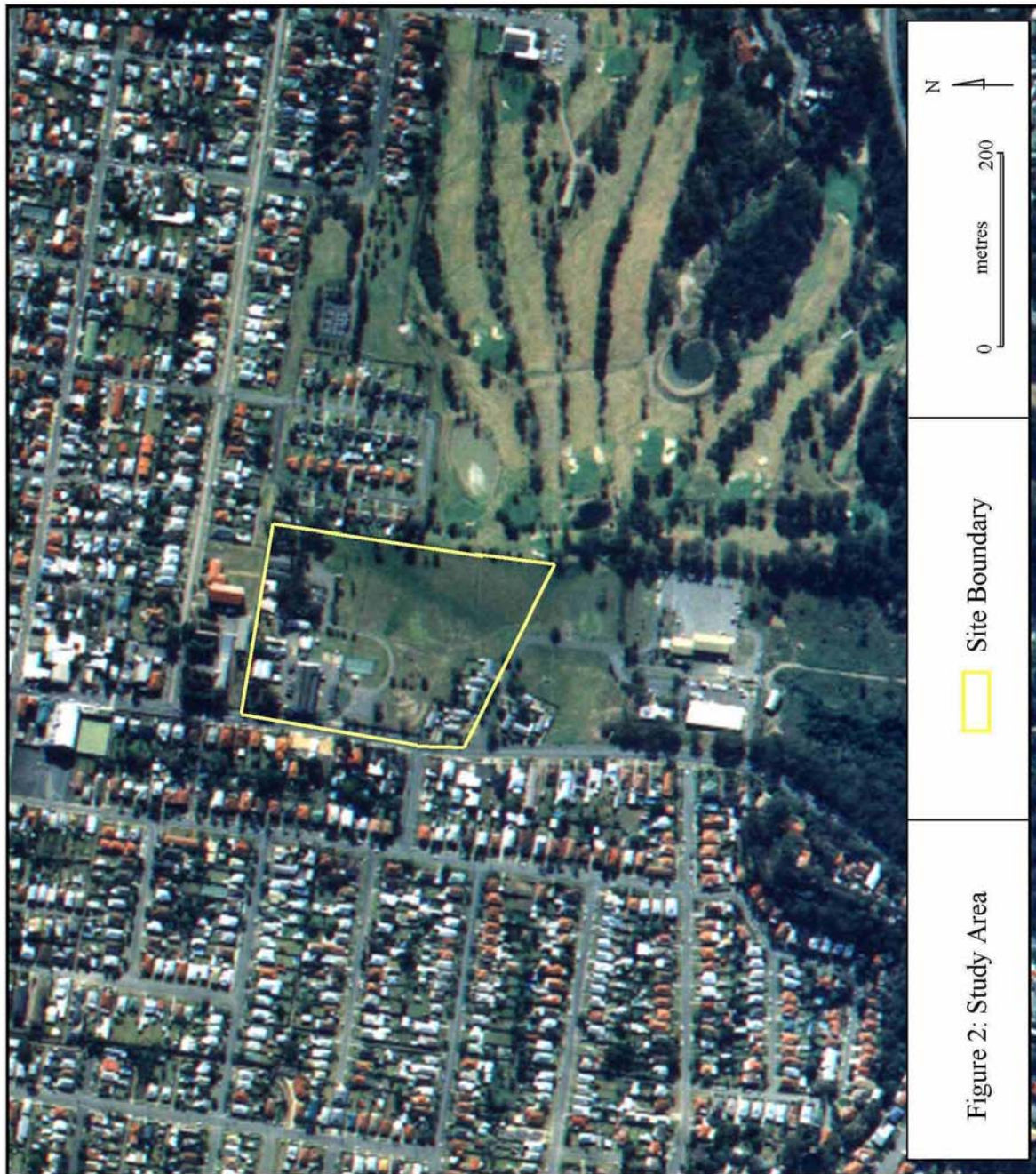
It is proposed that 72 residential dwellings and associated infrastructure be constructed within the study area for Army personnel (Figure 3). It is envisaged that the majority of the site will be cleared as a result of the proposal.

2.0 SCOPE OF THE STUDY

This study was designed to address any likely flora and fauna issues of significance occurring upon the site. This was achieved by appraisal of the vegetation assemblage and structural formation, and identification of representative plant species of the various structural layers. Potential habitat offered by the vegetation present was also assessed. The possibility of this site being significant for any Schedule 1 and 2 (endangered and vulnerable) flora or fauna species was paramount in the assessment process. Appraisal has been confined to the site, although surrounding habitats have been considered in the Section 5A assessment.



Figure 1: Site Locality Map





2.1 LEGISLATIVE REQUIREMENTS

This Eight Part Test Report has been structured upon the guidelines laid down in Section 5A of the Environmental Planning and Assessment Act (1979), and the Threatened Species Conservation Act (1995), which requires consideration of the impact of the proposed development upon any Schedule 1 and 2 (endangered or vulnerable) species expected or found on the site. Endangered and vulnerable species are collectively referred to as ‘threatened’ species in this report. The fieldwork was conducted under the NSW National Parks and Wildlife Service Scientific Investigation Licence A2081.

3.0 METHODOLOGY

Fieldwork was undertaken in the afternoon and early evening of Tuesday 7th May, 2002. The prevailing weather conditions were fine, warm with a slight breeze. Cooler conditions were experienced during the early evening.

3.1 VEGETATION APPRAISAL METHODOLOGY

The vegetation was appraised during a site inspection, and note was made of the vegetation assemblage and structural formation. Identification of representative plant species of the various structural layers was also undertaken. Searches for threatened plants as listed in the various schedules of the Threatened Species Conservation Act (1995) were undertaken using the 'Random Meander Technique'. This technique involves walking in a random manner throughout the entire study site, visiting the full range of potential habitats and checking every plant species seen (Cropper, 1993).

3.2 HABITAT APPRAISAL METHODOLOGY

Habitat may be defined as the physical and biological environment required for the survival of a specific population of a species. In modern usage habitat has also come to be regarded as an association of landform and plant life which provides sustenance and shelter for a particular fauna assemblage. In this report both approaches will be taken.

The methodology of the habitat appraisal used the vegetation community data combined, where relevant, with geomorphological features and the occurrence of particular plant species or forms (i.e. tree hollows) to provide a basis for a subjective habitat assessment aimed at placing the ecological status of the site within a local perspective.

3.2.1 GENERAL HABITAT FOR NATIVE SPECIES

From the vegetation appraisal and a general inspection of the site and surrounding areas, a subjective assessment of the general habitat value of this site was made. Considered in this assessment were:

- occurrence of that habitat type in the general vicinity;
- degree of disturbance and degradation;
- area occupied by that habitat on site;
- continuity with similar habitat adjacent to the site, or connection with similar habitat, off site by way of corridors; and
- structural and floral diversity.

3.2.2 HABITAT FOR SIGNIFICANT SPECIES

This site was evaluated as potential habitat for each of the threatened species reported on the NPWS Database from within 10km of the site. This evaluation was based on home-range, feeding, roosting, breeding, movement patterns and corridor requirements for fauna and hydrology, soil types, aspect and structural formation for flora species.

3.3 FAUNA APPRAISAL METHODOLOGY

The methodology adopted consisted of an assessment of the potential use of the site by any Schedule 1 and 2 fauna identified in the NPWS Database. This was undertaken by both appraising the extent of likely habitat upon the site, searches for secondary indications of threatened species utilising the site, and incidental observations of native fauna in general.

Following a preliminary site inspection, it was considered that trapping would not need to be undertaken as the site consisted of a cleared understorey, produced by mowing and isolated areas of landscaped vegetation with no evident hollows.

3.3.1 NOCTURNAL SURVEY

The nocturnal survey undertaken on the site consisted of one person hour of spotlighting and 45minutes of mobile microchiropteran bat call detection. The spotlighting involved the use of a 55W hand-held torch traversing the site on foot. The bat call survey was undertaken at the same time using an Anabat Detector recording to audio cassette. Any calls recorded were analysed using an Anabat Zero Crossing Analysis Interface feeding into a computer and identified by comparison with sample bat calls supplied by the manufacturer of the equipment.

3.3.2 GENERAL OBSERVATIONS & SEARCHES

Opportunistic sightings of species and secondary indications (scats, scratches, diggings, tracks etc.) of resident fauna were noted and included:

- searches in suitable areas for herpetofauna;
- searches for whitewash, prey remains and regurgitation pellets from Owls;
- searches for chewed (*Allo*)*Casuarina* cones from Black-Cockatoos;
- checks for obvious nests of raptors such as the Osprey;
- investigation of any possible den sites for Tiger Quoll;
- searches for fruit remains from feeding Fruit-Doves;
- checking trees (particularly smooth-barked species) for scratches consistent with arboreal mammals;
- searches for characteristic scats, such as from Koalas.

3.4 SIGNIFICANT SPECIES

The following threatened species have been collectively addressed under Section 5A of the EPA Act (1979) in Section 5.0 of this report:

<i>Angophora inopina</i>	Bush Apple
<i>Diuris praecox</i>	Donkey Orchid
<i>Syzygium paniculatum</i>	Magenta Lillypilly
<i>Tetratheca juncea</i>	Black-eyed Susan
<i>Litoria aurea</i>	Green and Golden Bell Frog
<i>Lathamus discolor</i>	Swift Parrot
<i>Neophema pulchella</i>	Turquoise Parrot
<i>Xanthomyza phrygia</i>	Regent Honeyeater
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove
<i>Ptilinopus superbus</i>	Superb Fruit-Dove
<i>Pandion haliaetus</i>	Osprey
<i>Lophoictinia isura</i>	Square-tailed Kite
<i>Ninox connivens</i>	Barking Owl
<i>Ninox strenua</i>	Powerful Owl
<i>Tyto novaehollandiae</i>	Masked Owl
<i>Phascolarctos cinereus</i>	Koala
<i>Petaurus norfolcensis</i>	Squirrel Glider
<i>Dasyurus maculatus</i>	Tiger Quoll
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat
<i>Miniopterus australis</i>	Little Bentwing-bat
<i>Miniopterus schreibersii</i>	Large Bentwing-bat
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat

4.0 RESULTS

4.1 FLORA ASSEMBLAGES

For the purposes of this survey, two vegetation communities were identified on site being overgrown Landscaped Woodland and Open Grassland (Figure 4*).

(*Note On Vegetation Map: A map of vegetation of any area seeks to describe the distribution of the plant species in that area by defining a number of vegetation units (assemblages or communities) which are relatively internally homogenous. Whilst such mapping is a convenient tool, it greatly oversimplifies the real situation. Plants rarely occur in well defined communities with distinct boundaries. Accordingly, vegetation units used for the accompanying map should be viewed as generalised plant species assemblages which gradually merge into each other. The assemblage boundaries shown on the map are indicative of their extent rather than being precise edges of communities.)

The remnant patches of overgrown Landscaped Woodland were noted within the northern portion of the site and were dominated by native species such as *Syncarpia glomulifera* (Turpentine), *Eucalyptus eugenioides* (Thin-leaved Stringybark) and *Eucalyptus viminalis* (Manna Gum). Additional native species identified were *Corymbia maculata* (Spotted Gum), *Eucalyptus sideroxylon* (Red Ironbark), *Lophostomon confertus* (Brush Box), *Casuarina glauca* (She Oak), *Grevillia robusta* (Silky Oak) and *Schefflera actinophylla* (Umbrella Tree). Exotic species identified include *Erythrina vespertilis* (Bats-wing Coral Tree), *Plumeria lutea* (Golden Frangipani), *Cinnamomum camphora* (Camphor Laurel), *Cotoneaster glaucophyllus*, *Ochna serrulata*, *Ligustrum sinense* (Small-leaved Privet), *Nerium sp.* (Oleander), *Camellia japonica* (Camellia), *Athrotaxis cupressoides* (Pencil Pine) *Morus nigra* (Mulberry), *Populus nigra* (Lombardy Poplar) and *Pinus radiata* (Radiata Pine). Two specimens of the threatened flora species *Syzygium paniculatum* (Magenta Lillypilly) were identified in the north-eastern area of the site which also appear to be planted.

Within the landscaped areas, the shrub layer was identified around the previously existing buildings and the boundary fence line. The shrub species identified were *Pittosporum undulatum* (Sweet Pittosporum), *Melaleuca armillaris* (Bracelet Honeymyrtle), *M. styphelioides* (Prickly-leaf Paperbark), *Callistemon sp.*, *Grevillea bipinnatifida x banksii* (Robin Gordon) and *Leptospermum polygalifolium* (Lemon-scented Tea-tree).

The areas of Open Grassland dominated the site and were comprised of common pasture species with scattered, small native trees such as *Eucalyptus punctata* (Grey Gum), and *Eucalyptus viminalis* (Manna Gum). The density of the grass layer varied from dense in the north-eastern portion to more sparse in the south-eastern corner. The grass species identified included *Microlaena stipoides* (Rice Meadow Grass), *Heteropogon contortus* (Bunch Speargrass), *Chloris gayana* (Rhodes Grass), *Deyeuxia quadriseta* (Reed Bent Grass), *Briza maxima* (Quaking Grass), *Themeda australis* (Kangaroo Grass), *Rhynchelytrum repens* (Red Natal Grass), *Echinopogon caespitosus* var.



caespitosus (Tufted Hedgehog Grass), and *Eragrostis cilianensis* (Stink Grass). The south-eastern area of the site was dominated by *Stenotaphrum secundatum* (Buffalo Grass), and *Cynodon dactylon* (Common Couch). Common ground cover weed species were also identified within the site and included species such as *Nephrolepis cordifolia* (Fishbone Fern), *Bidens pilosa* (Cobbler's Pegs), *Foenecium vulgare* (Fennel), *Protasparagus plumosus* (Creeping Asparagus Fern), *Hypochoeris* sp. (Catsear), *Senecio madagascariensis* (Fireweed), *Rumex* sp. (Doc), *Verbena bonariensis* (Purple Top), and *Oenothera* sp. (Evening Primrose).

4.1.1 THREATENED PLANTS

Four threatened plant species have been previously recorded within 10km of the site on the NPWS database, being:

<i>Angophora inopina</i>	Bush Apple
<i>Diuris praecox</i>	Donkey Orchid
<i>Syzygium paniculatum</i>	Magenta Lillypilly
<i>Tetratheca juncea</i>	Black-eyed Susan

Extensive searches and careful cross-checking of any similar species detected was undertaken across the study area during the field investigation. Two specimens of *Syzygium paniculatum* (Magenta Lillypilly) were identified within the north-eastern portion of the site. These specimens displayed landscaped characteristics i.e. planting at equidistant space along a straight line. As such, it is not believed that these specimens form part of a local population of this species. Further habitat evaluation of these species is given in Section 4.2 of this report.

None of the remaining threatened plant species assessed were noted on site during fieldwork.

4.2 HABITAT APPRAISAL

4.2.1 HABITAT DESCRIPTION AND DISTRIBUTION IN THE VICINITY

The site was assessed as potential habitat for native species. The site's highly modified native vegetation is a habitat type common in urban areas. Similar habitat is contiguous with the site to the east on the Merewether Golf Course and to the south.

The site offers viable potential foraging and nesting habitat for several guilds of avifauna. Nectarivorous species would find seasonal foraging resources, in the form of flowering *Syncarpia*, Eucalypt, *Grevillea*, *Melaleuca* and *Leptospermum* species. The dense grass layer may provide some resources for granivorous avifauna species such as finches. Birds of prey may also find hunting resources in the open areas of grassland across much of the site. Nesting opportunities are limited for

many species, however, smaller birds and those species not dependant on hollows may find suitable nesting opportunities over much of the site.

Limited foraging resources for arboreal mammals such as possums are available within the northern portion of the site although suitable nesting resources are largely absent. The presence of flowering *Syncarpia*, *Eucalypt*, *Grevillea*, *Melaleuca* and *Leptospermum* species may also provide a limited seasonal nectar resource for Flying-foxes but roosting habitat is absent.

Potential habitat for small terrestrial mammals is present on site, given the areas of dense groundcover and the occurrence of old concrete slabs for shelter and foraging. Reptiles may find shelter and foraging resources within the thick layers of ground cover over much of the site, while clearer areas such as the remnant concrete slabs from previously existing buildings provide potential basking areas. Habitat opportunities for amphibians on site are limited to those species not dependant on permanent water and such habitat is available within the southern portion of the site within the drainage lines.

Potential hunting habitat for microchiropteran bats is available over the site and adjacent areas. Potential roost sites are limited to the remains of an old basement of a previously existing building.

4.2.2 HABITAT FOR SIGNIFICANT SPECIES

4.2.2.1 *ANGOPHORA INOPINA*

Angophora inopina (Charmhaven Apple) is found in Open Dry Sclerophyll Woodland dominated by *Eucalyptus haemastoma* (Scribbly Gum) and *Corymbia gummifera* (Red Bloodwood) with a dense shrub understorey occurring on deep white sandy soils over sandstone. This preferred vegetation community and associated soil type is not present and therefore no suitable habitat is available on site.

4.2.2.2 *DIURIS PRAECOX*

Diuris praecox (Donkey Orchid) is often found growing in Eucalypt forests on hilltops or slopes. Potential habitat is available on site, however the quality of the habitat present is believed to have been marginalised by the high level of disturbance that the site has been subject to in the past.

4.2.2.3 *SYZYGIVM PANICULATUM*

Syzygium paniculatum (Magenta Lillypilly) occurs in coastal rainforests on sandy soils or stabilised coastal dunes. Preferred habitat is not available within the site, however, two cultivated species were identified in the northern portion of the site.

4.2.2.4 TETRATHECA JUNCEA

Tetralathea juncea (Black-eyed Susan) occurs in sandy heath and dry sclerophyll forests throughout its range. Additional preferred habitat attributes noted for this species include sloping sites below ridgelines, sites with a predominantly south-east aspect and areas providing partial shade such as in Open Woodlands. Due to the highly disturbed nature and lack of preferred habitat attributes the study area provides only marginal habitat for this species.

4.2.2.5 GREEN AND GOLDEN BELL FROG

Litoria aurea (Green and Golden Bell Frog) inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. *L. aurea* is thought to be displaced from more established sites by other frog species thus explaining its existence on disturbed sites. Marginal habitat in drainage lines and drains is available for the species on site.

4.2.2.6 REGENT HONEYEATER

Xanthomyza phrygia (Regent Honeyeater) forages on large Eucalypt flowers, mistletoe, Banksia flowers, and arthropods. The Regent Honeyeater nests in the fork of a tall tree. Limited suitable foraging habitat is available within the northern portion of the site.

4.2.2.7 PARROTS

Lathamus discolor (Swift Parrot) inhabits mainland Australia during winter, returning to eastern Tasmania in spring to breed. The Swift Parrot prefers open forest to woodland and has also been recorded utilising street trees and in parks and gardens. The preferred winter food species are *Eucalyptus sideroxylon* (Red Ironbark), *E. albens* (White Box), *E. ovata* (Swamp Gum), *E. robusta* (Swamp Mahogany) and *E. melliodora* (Yellow Gum) and they have also been observed eating the seeds and flowers of *Xanthorrhoea* spp. (Grass Trees). They also feed on insects and their larvae, fruits, berries, seeds and vegetable matter. Limited foraging habitat is available within the northern portion of the site.

Neophema pulchella (Turquoise Parrot) lives on the edges of Eucalypt woodland adjoining clearings and on timbered ridges and creeks in farmland, roadside verges and orchards. This species forages primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of moss. Breeding pairs nest in small hollow branches of Eucalypts, usually 1m above the ground from August through December and from April to May. Limited foraging habitat is available within the northern portion of the site however potential nest sites are absent.

4.2.2.8 FRUIT DOVES

The Fruit-Dove species, *Ptilinopus magnificus* (Wompoo Fruit-Dove) *Ptilinopus regina* (Rose-crowned Fruit-Dove) and *Ptilinopus superbus* (Superb Fruit-Dove) are frugivorous rainforest specialists inhabiting the canopy of sub-tropical, warm-temperate and depauperate rainforests. *Ptilinopus regina* and *P. superbus* will also feed in adjacent Mangroves or Eucalypt forest, venturing into coastal habitats at various times of the year, particularly during winter. The site does not constitute potential nesting habitat for these species, however, the fruit-bearing trees may provide a limited foraging resource for *Ptilinopus regina* and *P. superbus*.

4.2.2.9 OSPREY

Pandion haliaetus (Osprey) inhabits open and swamp forest adjacent to the coast or estuaries and fishes in brackish or salt water, seldomly in fresh water bodies. It builds a conspicuous stick nest on a dead tree or branch, which it uses for breeding between April and November. The study area does not provide potential nesting or hunting habitat for this species.

4.2.2.10 SQUARE-TAILED KITE

Lophoictinia isura (Square-tailed Kite) is a migratory species which occurs within open forest and woodlands in coastal and sub-coastal regions and may also range into nearby open habitats but not into extensive treeless regions. The Square-tailed Kite is notably absent from small isolated remnant woodlands in large open areas. The species hunts passerines, foliage insects, mammals and lizards. The study area constitutes, marginal at best, habitat for this species.

4.2.2.11 OWLS

Ninox connivens (Barking Owl) inhabits coastal and inland forest, woodland, savanna and paperbark woodlands. It sometimes roosts in rainforests, but it requires the more open country for hunting and hollow Eucalypts for breeding. The species prey on mammals and birds, though it also feeds on insects and other invertebrates.

Ninox strenua (Powerful Owl) inhabits a wide range of vegetation types from wet eucalypt forest with a rainforest understorey to dry open forest and woodlands. This species nests in a slight depression in the wood-mould on the base of a cavity in a large tree, sometimes in excess of 25 metres above the ground and roost during the day amid thick vegetation.

Tyto novaehollandiae (Masked Owl) also inhabits a wide range of environments from tall, wet eucalypt forest to dry woodland. During the day they tend to roost and nest in large hollows inside large old trees. They also may roost by day amongst the dense foliage of *Syzygium sp.* (Lillypilly) and other rainforest species.

The study area may provide hunting habitat for these Owl species however suitable roosting and nesting habitat is considered absent due to the lack of dense foliage and tree hollows.

4.2.2.12 KOALA

Phascolarctos cinereus (Koala) is restricted in distribution to forests containing specific Eucalypt species. Several specimens of *Eucalyptus punctata* (Grey Gum), a recognised Koala Feed Tree Species as per Schedule 2 of the State Environmental Planning Policy 44 - 'Koala Habitat Protection', were identified in the southern area of the site. As such, the site provides potential habitat for this species.

4.2.2.13 SQUIRREL GLIDER

Petaurus norfolcensis (Squirrel Glider) occurs in sclerophyll forests and woodland areas dominated by Eucalypts and requires tree hollows for nesting. The Squirrel Glider eats a high proportion of invertebrates from the foliage of eucalypts and acacias supplemented by plant exudates in the form of *Eucalyptus* and *Melaleuca* sap, and *Acacia* gum. Due to the lack of hollow-bearing trees and the sparsity of potential foraging habitat, the study area is not considered to provide suitable habitat for this species.

4.2.2.14 TIGER QUOLL

Dasyurus maculatus (Tiger Quoll) inhabits sclerophyll forests, rainforests and coastal woodlands. Nests are made in rock caves and hollow logs or trees, and basking sites are usually found nearby. The study area does not provide potential habitat for this species.

4.2.2.15 GREY-HEADED FLYING-FOX

Pteropus poliocephalus are known to occupy a variety of habitats, including wet and dry sclerophyll forests, rainforest, mangroves and paperbark swamps and *Banksia* woodlands. The predominant food source is Eucalypt blossom and fruits from trees such as *Ficus* spp. (Figs). The occurrence of Eucalypt trees, Lillypillys, Camphor Laurels, Privets, and a Fig tree on site provides limited seasonal foraging resource for this species.

4.2.2.16 MICROCHIROPTERAN BATS

Mormopterus norfolkensis (Eastern Freetail-bat) lives in sclerophyll forest and woodland. Small colonies have been found in tree hollows or under loose bark, specimens have been collected from under house roofs and the metal caps on telegraph poles.

Miniopterus australis (Little Bentwing-bat) and *Miniopterus schreibersii* (Large Bentwing-bat) inhabit tropical rainforest to warm-temperate wet and dry sclerophyll forest along the coastal plains and ranges. *M. australis* is a sub-canopy hunter with a preference for well-timbered areas but is also known to hunt in clearings adjacent to forests. *M. schreibersii* generally hunts above the canopy and has been recorded in a variety of habitats. These species roost in caves or similar man-made structures.

Scoteanax rueppellii (Greater Broad-nosed Bat) also roosts in tree hollows and has been known to inhabit the roof spaces of old buildings. *S. rueppellii* hunts along tree-lined creeks and vegetation ecotones (i.e. woodland and cleared paddock).

The site provides potential hunting habitat for all of the above microchiropteran bat species however roosting habitat is limited to the remains of an old basement of a previously existing building.

4.3 FAUNA APPRAISAL RESULTS

4.3.1 NOCTURNAL SURVEY

During the spotlighting survey a specimen of *Pteropus poliocephalus* (Grey-headed Flying-fox) was seen flying over the site. As this species is listed as threatened it has been given further consideration under Section 5A of the EPA Act (1979) in Section 5.0 of this report.

Two species of microchiropteran bat were recorded on site during the microchiropteran bat call detection survey, being *Chalinolobus gouldii* (Gould's Wattled Bat) and *Miniopterus schreibersii* (Large Bentwing-bat). The latter mentioned species is listed as threatened and accordingly has been given further consideration under Section 5A of the EPA Act (1979) in Section 5.0 of this report.

4.3.2 GENERAL OBSERVATIONS & SEARCHES

Avifauna species directly noted on site during fieldwork were *Platycercus eximius* (Eastern Rosella), *Gymnorhina tibicen* (Magpie), *Corvus coronides* (Australian Raven), *Passer domesticus* (House Sparrow), *Streptopelia chinensis* (Spotted Turtle-dove), *Cacatua roseicapilla* (Galah), and *Manorina melanocephala* (Noisy Miner). Also noted foraging in the south-eastern area of the site were a pair of *Vanellus miles* (Masked Lapwing) and a flock of *Threskiornis spinicollis* (Straw-necked Ibis).

Lampropholis delicata (Grass Skink) was identified across much of the site, and scratches on the bole of a tree were consistent with *Varanus varanus* (Monitor).

None of these species identified on site are considered threatened.

Additional observations included:

- Searches on site yielded no sign of any Koala activity.
- No sign of any conspicuous nest consistent with Osprey was noted.
- No fruit remains indicating past feeding by Fruit-Doves was noted.
- No chewed (*Allo*)*Casuarina* cones resultant from past feeding by Black-Cockatoos was noted.
- No whitewash, regurgitation pellets or prey remains consistent with owls were noted.
- No possible den site for the Tiger Quoll was found.

5.0 CONSIDERATIONS UNDER SECTION 5A OF THE EPA ACT

Considerations of the effects of the proposed development under the guidelines of Section 5A of the Environmental Planning and Assessment Act (1979) for the concerned threatened species is given below. The species dealt with are listed in Section 3.4. Descriptions of the ecology of these species are given in Appendix A.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of Sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on this threatened species, populations or ecological communities, or their habitats:

- a) *in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

Three threatened species were recorded on or above the site being, *Syzygium paniculatum* (Magenta Lillypilly), *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Miniopterus schreibersii* (Large Bantwing-bat).

Two specimens of *Syzygium paniculatum* were identified in the northern portion of the site during fieldwork. Given the location of these within the landscaped areas it is believed that these specimens are not naturally a part of a local population. Accordingly the removal of these specimens to accommodate the proposed development is unlikely to disrupt the life cycle of this species or place any viable local population of Magenta Lillypilly at risk of extinction.

While the specimen of *Pteropus poliocephalus* was seen flying over the site rather than utilising the site at the time of the survey, it is recognised that potential seasonally foraging habitat is available on the site in the form of flowering Eucalypt trees, Lillypillys, Camphor Laurels, Privets, and a Fig tree. However, the potential habitat is limited in size and the local Grey-headed Flying-fox colony is unlikely to be solely dependent upon the resources present on site. Accordingly, the removal of the vegetation from the site is unlikely to disrupt the life cycle of this species or place any viable local population at risk of extinction.

Miniopterus schreibersii utilises caves, culverts and similar structures for roosting purposes. A basement from an old building provides potential roosting habitat, however no evidence was found of the basement being used as a roost by microchiropteran bats. Accordingly, it is considered that this species is utilising the site as hunting habitat only. Due to the small size of the site and its disturbed nature it is unlikely that *M. schreibersii* is solely dependent upon the site for hunting purposes. Due to the generalist hunting habitat requirements for this species it is considered unlikely that the

development of this site would disrupt the life cycle of this species or place any viable local population of *M. schreibersii* at risk of extinction.

For the remaining threatened flora species considered in the habitat assessment, the site is believed to provide potential habitat for *Tetradlea juncea* (Black-eyed Susan) and *Diuris praecox* (Donkey Orchid). However, in both cases the high level of past disturbance of the site reduce the quality of the potential habitat.

Whilst the site provides foraging/hunting resources for some of the threatened faunal species considered in the habitat assessment including, *Ninox connivens* (Barking Owl), *N. strenua* (Powerful Owl), *Tyto novaehollandiae* (Masked Owl), *Mormopterus norfolkensis* (Eastern Freetail-bat), *Miniopterus australis* (Little Bentwing-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat), the lack of critical habitat attributes such as hollow-bearing trees and caves/culverts would limit the habitat value of the site. Given the highly disturbed nature of the site and the relatively small, isolated patches of vegetation it is believed unlikely that any of the threatened species assessed would be solely dependant upon the limited resources present.

As such, it is considered unlikely that the development as proposed would have a significant effect upon any threatened species, populations or ecological communities occurring in the local area.

- b) *in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.*

No population of threatened species on this site has been identified under Schedule 1, Part 2 of the TSC Act 1995.

- c) *in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.*

No significant area of known habitat is to be removed or modified.

- d) *whether an area of known habitat is likely to be isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

No known areas of habitat are likely to be isolated as a result of the development.

e) *whether critical habitat will be affected.*

None of this site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) *whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Areas of potential habitat for the various threatened species considered are protected in several conservation areas, including the Wallingat, Booti Booti, Barrington Tops, Wollemi, Tomaree and Myall Lakes National Parks. Additionally areas such as Moffats Swamp Nature Reserve, Blackbutt Reserve and Shortland Wetlands Centre would provide some protected habitat in the region. The only species whose habitat may not be adequately reserved is the Koala.

g) *whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.*

'Clearing of Native Vegetation' has been listed as a Key Threatening Process under Schedule 3 of the TSC Act 1995. As the proposed development will involve the removal of some of the existing native vegetation it may be viewed as a threatening process. However, as it would appear that the majority of the native flora species on site are a result of former landscaping, in this instance the proposed development is believed to be of a very low threat to native vegetation.

h) *whether any threatened species, population or ecological community is at the limit of its known distribution.*

The following threatened species considered are not at their known limits of distribution in this locality: *Diuris praecox*, *Tetratheca juncea*, *Syzygium paniculatum*, *Lophoictinia isura*, *Lathamus discolor*, *Neophema pulchella*, *Xanthomyza phrygia*, *Pandion haliaetus*, *Ptilinopus magnificus*, *Ninox connivens*, *Ninox strenua*, *Tyto novaehollandiae*, *Phascolarctos cinereus*, *Petaurus norfolcensis*, *Dasyurus maculatus*, *Pteropus poliocephalus*, *Mormopterus norfolkensis*, *Miniopterus australis*, *Miniopterus schreibersii*, *Scoteanax rueppellii*, and *Litoria aurea*.

Any specimens of *Angophora inopina* identified on site would be nearing the limits of their known current distribution. *Ptilinopus regina* is rare south of Port Stephens, and *Ptilinopus superbus* is rarely seen south of the Hunter River

6.0 CONCLUSION

It is proposed that residential development and associated infrastructure be constructed on Lot 101, 4 Brunner Road, Adamstown.

This study site consists of approximately 5.252 hectares of land which has been previously cleared and occupied, as evidenced by a number of old concrete slabs and drains scattered across the study area. The site was found to support two vegetation communities being remnant patches of overgrown Landscaped Woodland and Open Grassland. The overgrown landscaped Woodland was identified within the northern portion of the site and sparsely scattered across the cleared areas of grassland.

Three threatened species were recorded on or above the site during the fieldwork, being *Syzygium paniculatum* (Magenta Lillypilly), *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Miniopterus schreibersii* (Large Bentwing-bat).

Two specimens of the threatened flora species *Syzygium paniculatum* (Magenta Lillypilly) were identified in the north-eastern area of the site within the landscaped areas and appear to have been planted. As these specimens are not believed to form part of a local population, and the ready availability of the species in Nurseries, no significant impact on the species is likely to result from the proposal. None of the remaining threatened flora species assessed were identified during fieldwork.

While the specimen of *Pteropus poliocephalus* was seen flying over the site rather than utilising the site at the time of the survey, it is recognised that potential seasonal foraging habitat is available on the site however, the potential habitat is limited in size and the local Grey-headed Flying-fox colony is unlikely to be solely dependent upon the resources present on site. It is considered that *Miniopterus schreibersii* is utilising the site as hunting habitat only. Due to the small size of the site and its disturbed nature it is unlikely that *M. schreibersii* is solely dependent upon the site for hunting purposes. Due to the generalist foraging and hunting requirements of these two bat species it is considered unlikely that the proposed development would adversely impact upon any viable local populations of these two species.

Whilst it was recognised that the site provides limited foraging/hunting resources for most of the threatened fauna species assessed the site lacks critical attributes such as hollow-bearing trees and caves/culverts. Given the highly disturbed nature of the site which has resulted in relatively small, isolated patches of vegetation it is believed unlikely that any of the threatened species assessed would be solely dependant upon the limited resources present on site. As such, it is considered unlikely that the development as proposed would have a significant effect upon any threatened species, populations or ecological communities.

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APPENDIX A

THREATENED SPECIES DESCRIPTIONS

1. *Angophora inopina* Bush Apple

Angophora inopina is found within open woodland/forest assemblages in co-dominant distribution with *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus capitellata* (Brown Stringybark), as well as within wet-dry heath, and swamp forest communities. These vegetation habitat attributes are located mainly on the Doyalson, Gorokan and Wyong soil landscapes (Bell, 2001). It has been estimated by Bell (2001), that *A. inopina* occupies approximately 1418ha of habitat.

The successful germination of *A. inopina* seed is believed to be rare under natural conditions, with the maintenance of populations in the short-term facilitated by coppice growth following disturbance (Bell, 2001). At present there is insufficient information to determine the extent of migration of seed propagules and pollen between stands of *A. inopina*. The majority of the known stands of this species occur within 1km of each other, between which it is believed that the exchange of genetic material could be expected (Bell, 2001).

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2. *Diuris praecox* Donkey Orchid

Diuris praecox is a double-tailed terrestrial orchid with small to moderate (25mm across) sized light yellow and brown flowers during July/August. It is often found growing in Eucalypt forests on hilltops or slopes (Bishop 1996). Species of the *Diuris* genus are very widespread in grassy habitats but can be easily missed because of their short flowering seasons, usually no more than two weeks. *D. praecox* is known from coastal areas between Ourimbah and Nelson Bay. This species is ROTAP-coded 2VC-.

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3. *Syzygium paniculatum* **Magenta Lillypilly**

Syzygium paniculatum, a member of the Myrtaceae family, occurs in coastal rainforests on sandy soils or stabilised coastal dunes from Jervis Bay to Buladelah in NSW. This species is a small to medium tree, 3-8m high, with dark, dense foliage. White flowers are in small dense axillary cymes with unequal sepals in summer. The common name of this species is derived from the pink to red colouring of the ripe fruit. The Magenta Lillypilly has been widely cultivated, and is readily available at whole sale and retail nurseries. This species is ROTAP-coded 3ECi.

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4. *Tetratheca juncea* **Black-eyed Susan**

Tetratheca juncea, a member the family Tremandraceae, occurs as a small shrub, with prostrate stems up to 60 cm long, usually less than 20 cm high. It has distinctly angular stems and branches with the leaves reduced to minute scales. It produces four petalled purple to pink flowers, mainly from August to November, although flowering outside these times are not uncommon. This species is distributed in generally coastal districts from about Buladelah south to the Lake Macquarie region. Populations were once known from the Port Jackson and Botany Bay areas, although it is thought that these may now be extinct. There appears to be a concentration of *T. juncea* occurrence in the Hunter and Central Coast.

T. juncea occurs in Heath and Dry Sclerophyll Forests throughout its range. Norton (1994) has described the preferred habitat attributes of *T. juncea* as:

- sites with clay soils derived from conglomerates with a neutral pH;
- sloping sites below ridgelines;
- sites situated between 30 and 70m above sea-level;
- sites with a predominantly south-east aspect;
- areas providing partial shade, as in Open Woodlands.

T. juncea has, however, been identified in different habitats to those described above and it is believed that the species is adaptable so long as micro-climatic conditions are favourable. The most commonly found associating species are, *Angophora costata* (Smooth-barked Apple), *Eucalyptus globoidea* (White Stringybark), *Corymbia gummifera* (Red Bloodwood), *Acacia myrtifolia* (Myrtle Wattle), *Acacia uncinatum*, *Pultenea stipularis*, *Dillwynia retorta* (Heathy Parrot Pea), *Leptospermum trinervium* (Paperbark Tea-tree) and *Gompholobium latifolium* (Broad-leaf Wedge-pea).

Previous surveys have located 46 populations around Lake Macquarie, with numbers ranging from tens to over one thousand plants (McReddie, 1992; Payne, 1993; SWC, 1994, Winning, 1992). Payne (2000) has condensed the previous definitions to 4 'populations', with 240 'sub-populations' (162 of which occur within the LMCC area). The estimation of the number of plants has also been modified to the frequency of 'clumps', due to the clonal and asexual reproduction of the species. Payne (1998; 2000) has also indicated that native sonicating bees are integral to the pollination of this

species, and that management of *T. juncea* may be dependant upon protection of adequate habitat for these pollinators. This species has been ROTAP-coded 3VCa, although there is evidence that a coding of 3VCi may be more appropriate.

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5. *Lathamus discolor*

Swift Parrot

The Swift Parrot is most closely related to rosellas, though its habits are most closely aligned with those of the lorikeets, which it also resembles morphologically. The main distinction of the Swift Parrot is the long red tail that is not found in lorikeets, which generally have dumpier green tails. During winter the Swift Parrot inhabits mainland Australia from Adelaide (S.A.) through Victoria, and up the east coast to south-east Queensland, as well as visiting the south and central western slopes and the Riverina in NSW. The Swift Parrot returns to eastern Tasmania in spring to breed.

The species appears to have declined greatly in the northern and eastern parts of its overwintering range to the extent that the NSW NPWS Scientific Committee has upgraded the listing of the Swift Parrot from Schedule 2 (Vulnerable) to Schedule 1 (Endangered) (NPWS Scientific Committee, 2000). The Swift Parrot is also listed under the Commonwealth Endangered Species Protection Act (1992) as 'Endangered'. Recent investigations have indicated that there may only be 1000 breeding pairs throughout its entire range (Forshaw 1993, Garnett 1993, Brereton 1998). The continued loss of foraging resources, in particular winter-flowering Eucalypt species, appears to be most serious short term threat to this species in NSW. The most recent records are from the tablelands and western slopes of southern and central NSW. Swift Parrots have also been recorded during the winter months of 2000 utilising areas in the vicinity of Aberdare State Forest (Roderick pers. comm.) and Millers Forest (Newman pers. comm.).

The Swift Parrot prefers dry sclerophyll in Tasmania and open forest to woodland in the north on the mainland. It has also been recorded utilising street trees and in parks and gardens. Swift Parrots forage on the nectar of Eucalypts, often in mixed flocks with lorikeets. The preferred winter food species are *Eucalyptus sideroxylon* (Red Ironbark), *E. albens* (White Box), *E. ovata* (Swamp Gum), *E. robusta* (Swamp Mahogany) and *E. melliodora* (Yellow Gum) and have also been observed eating the seeds and flowers of *Xanthorrhoea* spp. (Grass Trees). They also feed on insects and their larvae, fruits, berries, seeds and vegetable matter. While feeding, individuals may be approached and watched from under the feed tree. When there is an abundance of food, large congregations of hundreds of birds may gather in noisy and crowded roosts. Nesting occurs from September to January in a hollow branch of a Eucalypt and they return to the mainland during March and April.

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6. *Neophema pulchella*

Turquoise Parrot

This 'grass parrot' is a striking green with brilliant blue edges to the wings, on which the male of the species also displays a bright red patch. The main distribution of the Turquoise Parrot is in grassy woodlands of the western slopes and tablelands from the Darling Downs in Queensland to northern Victoria, particularly along watercourses. It lives on the edges of Eucalypt woodland adjoining clearings and on timbered ridges and creeks in farmland. It has also been recorded utilising roadside verges and orchards. They are usually seen in pairs or small groups and spend most of the day on the ground. This species forages primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of moss. They are approachable when feeding and have a characteristic flight call, which is described as a weak tinkling. Partly nomadic, flocks move locally and regionally following seasonal abundances of seed. Breeding pairs nest in small hollow branches of Eucalypts, usually 1m above the ground from August through December and from April to May. Two to five eggs are laid and young leave the nest after 30 days though remain with the parents. The species appears to be consolidating after a long history of decline.

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7. *Xanthomyza phrygia*

Regent Honeyeater

The Regent Honeyeater is a medium-sized, unique honeyeater. It is nomadic, although it does seem to return to nesting areas sporadically. Small flocks regularly, sometimes annually, visit the northern tablelands and the north western and central western slopes of NSW in the spring and summer. Individuals also appear on the NSW coast at most times of year but primarily in winter. It occurs in temperate woodlands and open forest, including forest edges. Once commonly observed in flocks of hundreds, it is thought that the current population may not number more than 1000 individuals. Regent Honeyeaters are now seldom seen west of Bendigo, Victoria and are only occasionally observed in southern QLD.

Seasonal movements appear to be dictated by the flowering of various species of Eucalypts that are characteristic of the dry forests and woodlands of south eastern Australia. The Regent Honeyeater prefers to forage on large-flowered Eucalypts (e.g. *Eucalyptus sideroxylon*, *E. melliodora*, *E. albens*, *E. leucoxydon*), particularly where these trees grow in more productive areas and yield plentiful and predictable nectar flows. They also forage on mistletoe and Banksia flowers, and arthropods. In parts of coastal NSW they are also attracted to stands of *Eucalyptus robusta* (Swamp Mahogany). Recent records (winter 2000) exist of this species foraging in flowering *Corymbia maculata* (Spotted Gum) trees at Aberdare State Forest near Ellalong, NSW (Roderick pers.comm.).

During winter, Regent Honeyeaters disperse widely in small groups. In spring they concentrate into the main breeding areas around Chiltern and Benalla in Victoria and the Capertee Valley, Bundarra District and the Warrumbungles in NSW. Other recent records suggest that the species may be breeding in the vicinity of Quorrobolong, near Cessnock, NSW (Geering pers. comm.). Nests are constructed of strips of Eucalypt bark, dried grass and other plant material. They are placed in an upright fork 4 to 25m above ground, and 2-3 eggs are laid. Nesting occurs mainly between November and January, but breeding has been recorded in all months between July and February.

The decline of the Regent Honeyeater appears to be due to a steady reduction in the extent and quality of its habitat. Many of the remaining stands of the 'key' Eucalypt species have suffered in the past from harvesting of timber and the very slow growth rates of replacement trees. Lack of regeneration due to grazing by stock and hence a lack of new trees to replace dying trees in farmland is also a serious concern.

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8. *Ptilinopus magnificus*

Wompoo Fruit-Dove

The Wompoo Fruit-Dove is distributed from Cape York (Qld.) along the coast and ranges south to the Hunter River (N.S.W.). The southern part of the species range has decreased, having once extended to the Shoalhaven River. This Fruit-Dove is a frugivorous Rainforest specialist inhabiting the canopy of Sub-tropical, Warm-temperate and Littoral Rainforests. Occasionally it will stray to fruiting trees outside of Rainforest areas. Breeding occurs between July and December and is linked to the fruiting cycles of favoured feed trees including Figs, Laurels, Myrtles and native Tamarind. The females lay one egg on a flimsy platform of vine tendrils on a slender horizontal branch. This species prefers relatively undisturbed to completely intact Rainforest.

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9. *Ptilinopus regina*

Rose-crowned Fruit-Dove

The Rose-crowned Fruit-Dove occurs in Eastern Australia, from Cape York south to the vicinity of Port Stephens. Occasionally it extends into Victoria. The Rose-crowned Fruit Dove generally lives in Rainforest, though it also frequents nearby drier forests as well as Mangroves. It usually feeds on Figs or other fruit and berry-bearing trees. The breeding season is from October to February, with a flimsy nest being constructed of twigs on a scanty platform in a low tree or bush. A seasonal movement of birds from the southern end of the range to the north occurs in winter, whilst others have been found to move seasonally in relation to the availability of fruit, with distance and direction traveled varying from one year to the next.

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10. *Ptilinopus superbus*

Superb Fruit-Dove

The Superb Fruit-Dove is quite common north of Cardwell, Qld; becoming uncommon nomads or non-breeding migrants further south to the Hunter River, with rare sightings recorded south to Tasmania. The Superb Fruit-Dove lives mainly in Rainforest but will feed in adjacent Mangroves or Eucalypt forest, venturing into coastal habitats at various times of the year, particularly during winter. Many winter-migrating birds in NSW often perish by flying into windows in residential areas (A. Morris, NSW FOC, pers. comm.). It usually feeds on Figs or other fruit-bearing trees. Breeding season is from October to February. The nest is usually a platform about 10cm in diameter, composed of a few twigs; built in a small tree on a horizontal fork, usually about 3 metres from the ground, and situated in Open Forest at the edge of scrub. The species may have one of the shortest nesting periods of any Pigeon, being perhaps no more than seven days.

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11. *Pandion haliaetus*

Osprey

The Osprey is a large fishing raptor with a distinct brown band passing through the eye. The Osprey is a very cosmopolitan species, found in most continents across the Earth. A single subspecies, *P. h. cristatus*, breeds in Australia and New Guinea. Southern and inland records show that the Osprey in Australia is able to travel long distances and have been recorded as far inland as the Finke River in Central Australia. It can be found in open and swamp forest adjacent to the coast or estuaries and fishes in brackish or salt water, seldomly in fresh water bodies. It feeds on live fish, usually 20-40 cm in length. Plunging into the water feet first, from heights up to 50 metres above the water, it will submerge itself to at least 1m when fishing. The talons grasp the prey with a grip that cannot be released, so large prey is generally avoided. The fish is carried away from the water angled head first to reduce drag on the return flight.

Individuals are sometimes seen inland along the larger northern rivers and the Murray River though breeding is usually confined to the coast and islands. It builds a conspicuous stick nest on a dead tree or branch, which it uses for breeding between April and November. Nesting sites are also found on man-made structures such as pylons or tall telegraph poles. The nest is added to by breeding pairs each year

until they reach a massive size. In some parts of its range overseas nests are as little as 10 m apart but in Australia most are separated by at least 1 km. A recent record of this species breeding exists from a nest with young found at Cundletown, south of Taree (Hunter Bird Observers Club, 2001).

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12. Lophoictinia isura

Square-tailed Kite

This raptor is endemic to Australia and is widespread throughout the mainland (absent from Tasmania). It is recorded mainly in coastal and subcoastal regions, although it has been observed inland. The species is migratory throughout its range and is a spring-summer breeding migrant to south-eastern, southern and south-western Australia. The Square-tailed Kite inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range into nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Within N.S.W. the species has been recorded in ridge and gully forests dominated by *Eucalyptus longifolia* (Woollybutt), *E. elata* (River Peppermint), *E. smithii* (Blackbutt Peppermint) and *Corymbia maculata* (Spotted Gum), as well as in forests of *Angophora* and *Callitris* with a shrubby understorey.

The Square-tailed Kite hunts mostly passerines and foliage insects, though it also known to take mammals and lizards. Most prey is taken from the canopy and rarely from shrubs or in the air. Breeding occurs from July to February with an average clutch size of 3 eggs. Nests are built as a platform or bowl of sticks lined with green *Eucalyptus* leaves in forks or large horizontal branches of *Eucalypts*, *Angophora* or *Melaleuca* trees and may be used in successive years.

Except when breeding *Lophoictinia isura* tends to be a solitary bird, usually seen hunting alone high in, or just above the tree canopy in coastal or sub-coastal rainforest, forest or woodland. Nests have been reported in *Eucalyptus* spp., *Angophora* spp. and native pine forests. Prey taken has included fledging birds, insects, rabbits and lizards.

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13. *Ninox connivens*

Barking Owl

The Barking Owl is found in forest and woodland, encountered most commonly in savanna and paperbark woodlands. It sometimes roosts in rainforests, but it requires the more open country for hunting and hollow Eucalypts for breeding. It is quite common in its favoured habitat, particularly in Northern Australia. These owls are usually found in pairs which occupy permanent territories, generally greater than 100 ha. Each pair has a number of sites where they roost by day - usually in a leafy tree, close to the trunk, though not always well hidden. When three or four Barking Owls are seen roosting together, the extra birds are the young of that year. They breed August to October in large open hollows. The main call of the species is a repetitive barking 'wook wook', hence the common name. It does occasionally produce a rather loud and disturbing scream which has earned it a second common name of the 'screaming woman bird'.

Mammals and birds are the main prey, though it also feeds on insects and other invertebrates. In Southern Australia it feeds particularly on rabbits. It also kills hares, rats, mice, occasional small bats and some marsupials, including possums. It kills birds up to the size of Magpies and Tawny Frogmouths. Any prey too big to be swallowed whole is torn up and eaten piece by piece. The rear parts of victims are sometimes found beneath roost trees.

This species is known from coastal and inland areas throughout Australia away from the deserts and arid interior.

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14. *Ninox strenua*

Powerful Owl

The Powerful Owl is found in the coastal areas and adjacent ranges of eastern Australia from South Australia to around Rockhampton in Queensland, generally within 200km from the coast. Within NSW, Powerful Owls are distributed throughout the length of the Great Dividing Range, which is their stronghold, and extend from the coast to the western slopes where they occur in much lower numbers. The Powerful Owl inhabits a wide range of vegetation types from wet Eucalypt forests with a Rainforest understorey to Dry Open Forests and Woodlands. The species has been recorded utilising disturbed habitats such as exotic pine plantations and large trees in parks and gardens. A resident pair of Powerful Owls have been recorded in recent years from Blackbutt Reserve, near Newcastle, NSW. It appears that

this pair successfully reared two young during the 2001 breeding season (HBOC, pers. comm.).

The Powerful Owl is the largest predator of nocturnal forest-dwelling animals in Australian forests. Major prey species in NSW forests are the Greater Glider, Common Ringtail Possum, Sugar Glider, Grey-headed Fruit Bat, and several species of diurnal birds, including the Pied Currawong, Magpie and Lorikeets. It rests during the day amid thick foliage, often grasping food-remains. The male of the species employs a slow, far-carrying 'who-hoo' call, more deliberate than the females call, which is higher pitched with the second note slightly higher than the first.

Powerful Owls nest in a slight depression in the wood-mould on the base of a cavity in a large old tree, sometimes in excess of 25 metres above the ground. These trees are usually found growing on a hillside in heavy forest and may be utilised intermittently for several years. The breeding season of the Powerful Owl is highly synchronised, being strictly winter breeders. One or two young are produced, although some pairs do not breed in every year. Pairs appear to mate for life and occupy exclusive territories which can be greater than 800ha in size (Kavanagh, 2000).

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15. *Tyto novaehollandiae*

Masked Owl

Masked Owls in NSW are distributed throughout the length of the Great Dividing Range and extend from the coast to the western slopes. Within this range they inhabit a range of wooded habitats that contain both mature trees for roosting and nesting and more open areas for hunting. They are most commonly encountered within Open Forest with a sparse understorey as well as along the ecotones of these areas to more or less densely vegetated habitats. There is much evidence to suggest, however, that the species is not entirely restricted to forested habitats and will readily hunt along the ecotone between wooded habitats and a range of open habitats such as pastoral land (Marchant, 1999 and references cited therein). Their diet comprises mainly ground-dwelling prey, including several species of native and introduced Rodents, *Antechinus* spp. and Bandicoots. On occasions, other prey such as Possums, Gliders and other birds are taken. Strictly nocturnal, Masked Owls will perch for long periods, up to several hours, in an exposed area, waiting to ambush a passing prey animal.

Masked Owls are recognised as being the least common of the three large forest Owls in NSW (Kavanagh and Murray, 1996). Evidence suggests that the species may be secure eastwards of the Great Divide in forests that are not intensively logged, although it may be threatened in cleared and overgrazed areas westwards of the range (Debus and Rose, 1994). The paucity of records of Masked Owls in NSW appears unusual due to the species dietary flexibility and its ability to utilise disturbed habitats (Kavanagh, 1996). This may be due to the apparent reluctance to vocalise during non-breeding periods, making the species difficult to detect for most of the year.

Masked Owls usually roost in large hollows inside large, old living trees, most often Eucalypts. Within dry forests they often choose hollow trees in gullies or drainage lines. These hollows are 1 to 5 metres deep, 40 to 50 cm wide. The trees containing these hollows are likely to be quite old (>150 years). They are also known to roost among the dense foliage of other trees such as *Pandanus*, *Livistona*, *Melaleuca* and *Acacia* species. There are also records of Masked Owls roosting in introduced pine trees and in shrubs in gardens and suburban areas (Marchant, 1999 and references cited therein). The species also nests in large hollows, although there appears to be a preference for hollow tree trunks and vertical spouts of large trees. The breeding season, like that for other *Tyto* owls, is variable but there is a tendency for breeding to occur in autumn-winter. Two or three young are produced, although some pairs do not every year. Pairs appear to mate for life and occupy exclusive territories in order of 1000ha in size. A radio-tracked bird near Newcastle was found to utilise a home-range of between 1017-1178ha (Kavanagh and Murray, 1996) and another documented pair of Masked Owls in the North Lake Macquarie area may possibly be utilising a home range of up to 1700 hectares (Young, 1998).

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16. *Phascolarctos cinereus*

Koala

The Koala occurs along the east coast of Australia and extends into woodland, mulga and River Red Gum forests west of the Great Dividing Range. Its range covers all such suitable areas of N.S.W. In drier forested areas, Koalas are generally observed as individuals in low densities. They are more abundant in coastal woodland and in open forest, where they have been found in densities as high as ten per hectare. They are rare or absent in wet forests in the south above 600 m which may be due more to distribution of Eucalypt species than climate, as the Koala is limited to areas where there are acceptable food trees. Its diet is generally restricted to that of Eucalypt leaves and much less-often, non-Eucalypt foliage. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum), *E. viminalis* (Manna Gum), and *E. robusta* (Swamp Mahogany) are some of the preferred Eucalypt species. Koalas use a wide variety of tree sizes, and do not preferentially use large or tall trees in NSW forests, although this has been listed as a habitat preference in areas where trees are generally small, stunted, or nutrient deprived.

Koalas sleep in the fork of a tree during the day and feed at night with the peak of activity just after sunset. It is generally a solitary animal with a social behaviour pattern that influences its breeding biology. Breeding biology of the Koala is characterised by the occurrence of discrete core breeding

groups which are sedentary. A core group may comprise up to several dozen individuals that are usually well separated from other breeding groups. These core groups produce a continual supply of dispersing nomadic sub-adults. Individual Koalas within core breeding groups occupy semi-exclusive territories. There is interaction with and marginal overlap of territories between adjacent individual animals. The territories of breeding males generally occur within a matrix of adjacent territories of breeding females. In the overlap zones of adjacent territories of breeding Koalas, individual trees occur that are habitually used for interaction between the two animals concerned. These breeding core interaction trees (sometimes termed "home range trees") are readily identifiable by scratched "trails" up the bole and copious dung deposits at the base of the tree. Breeding occurs in summer and young females produce one young (rarely twins) each year.

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17. *Petaurus norfolcensis*

Squirrel Glider

The Squirrel Glider is distributed throughout the dry sclerophyll forests and woodlands of eastern Australia from South Australia to Cairns. In Victoria its range was considered to be narrow where it inhabited remnant woodlands and open forests which have mature or mixed-age stands of more than one Eucalypt species, or riparian forests of *Eucalyptus camaldulensis* (River Red Gum). In NSW, the Squirrel Gliders' range has recently been extended to coastal habitats, including Swamp Mahogany Swamp forests on the Central Coast. In Victoria the Squirrel Glider occurs predominantly in dry woodland west of the Great Dividing Range. The full range of habitats in which it is found in NSW have not been fully reported in any literature.

The Squirrel Glider eats a high proportion of invertebrates from the foliage of Eucalypts and *Acacias* supplemented by plant exudates in the form of Eucalypt and *Melaleuca* sap and *Acacia* gum. Insects (Coleoptera) and caterpillars (larval Lepidoptera) were found to be very important in its diet. The plant exudates, honeydew, pollen and nectar were considered to be more important in winter and

spring. It is also likely that birds eggs are included in its diet. It is thought that a mixed stand of gum and high nectar producing Eucalypts, (including some which flower in winter) were important to support the Squirrel Glider. In coastal NSW forests a significant component may be mature *Acacia irrorata*, *Melaleuca styphelioides* or *M. nodosa*, providing late winter/early spring carbohydrates.

The breeding biology of the Squirrel Glider is probably similar to that of the Sugar Glider. It nests in a leaf-lined hollow in a tree or stump. Interbreeding between the Squirrel Glider and the Sugar Glider has been evidenced in captivity (Fleay, 1947), and is strongly suspected in the wild. Resultant offspring are noted as having intermediate characteristics between those of the two parent animals.

It has been reported that Squirrel Gliders are consistently preyed upon by cats and foxes and it has been believed that an increase in this predation may result from the opening up of bushland through rural-residential or other development. While this increased predation may adversely impact upon populations of this species it may not be the only impact causing the extinction of populations in developed areas. However, in the absence of detailed studies, it is believed that provided domestic cats are excluded, a rural-residential subdivision with a minimal amount of clearing and retention of adequate habitat connections may not have a significantly deleterious effect upon a population of these gliders.

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18. *Dasyurus maculatus*

Tiger Quoll

The Tiger Quoll is widespread in eastern Australia, with its distribution being spread between two subspecies. The nominate subspecies, *D. m. maculatus* occurs from southern QLD to Tasmania whereas *D. m. gracilis* occurs in northern QLD. This species is one of the largest carnivorous marsupials. It is an agile climber but spends most of its time on the floor of sclerophyll forests,

rainforests and coastal woodlands. Although largely nocturnal, it may forage and bask in the sun during the day. Nests are made in rock caves and hollow logs or trees, and basking sites are usually found nearby. It is an opportunistic hunter of a variety of prey, including birds and their young, rats and other small terrestrial and arboreal mammals, gliders, small Macropods, reptiles and Arthropods. It also scavenges on the carcasses of domestic stock. Sexual maturity is attained in one year, with mating occurring from April to July. Usually, there are 5 young to a litter and young are fully independent at 18 weeks.

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19. *Pteropus poliocephalus*

Grey-headed Flying-fox

The Grey-headed Flying-fox is distributed predominantly along the sub-tropical east coast, from Rockhampton (Qld) through NSW to SE Victoria. It is a fairly large species, weighing up to a kilogram and having a forearm length of up to 180mm. It is the only Australian Flying-fox to possess a mantle of rusty brown fur that full encircles the neck. The fur on the back is dark grey and as the common name suggests, the head is covered with light grey fur. The grey belly fur is often flecked with white and ginger. The fur extends down the legs to the toes., which contrasts with other *Pteropus* species, which are furred only to the knees.

Grey-headed Flying-foxes are known to occupy a variety of habitats, including wet and dry sclerophyll forests, rainforest, mangroves and paperbark swamps and *Banksia* woodlands. Here they forage on a range of fruits and blossoms. Their diet is so varied that they have been recorded eating the fruit or blossom of more than 80 species of plant. The predominant food source is Eucalypt blossom and fruits from trees such as *Ficus* spp. (Figs). It is likely to act as an important pollinator for many of the trees on which they utilise blossoms. They also inhabit cultivated areas where they feed on introduced trees including commercial food crops, and can become a 'pest' animal in these areas. Ironically, this has led to this species being the most intensively researched bat in Australia.

As with most species of Flying-fox, *P. poliocephalus* roost communally where they form large communal colonies called 'camps'. Camps are mostly in rainforest patches, mangroves, paperbark forests and modified vegetation in urban areas. These camps may contain thousands of individuals, and up to 200 000 individuals have been recorded at one camp. They may move up to 70km from the camp each night to forage. Young are raised in maternity camps after birthing in September to October. The young are able to fly at 3 months of age and puberty is reached at 18 months, although males do not achieve effective fertility until 30 months. Vocal communication is highly sophisticated, with over 20 different situation-specific calls being recorded.

The key threats to Grey-headed Flying-fox include the clearing or modification of native vegetation, in particular roost-camp habitat as well as winter food resources in NE NSW. This species is also threatened by persecution in the form of shooting of animals and the destruction of roost camps. This oppression may be a result of Grey-headed Flying-foxes being a perceived pest in agricultural areas or as presenting a noise problem in more urbanised areas. Recently, it has been identified as being a potential carrier of viral pathogens, such as Lyssa-virus. Another threat is from competition and hybridisation with *P. alecto* (Black Flying-fox).

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20. *Mormopterus norfolkensis*

East Coast Freetail-bat

This species is distributed along the east coast of New South Wales from south of Sydney extending north into south-eastern Queensland, near Brisbane. There are no records west of the Great Dividing Range. This species appears to live in Sclerophyll Forests and Woodland. Usually only solitary bats are captured, but one group was caught flying low over a rocky river in Rainforest and Wet Sclerophyll Forest. When hunting insects it flies swiftly above the forest canopy or in clearings at the edge of the forest. Their diet is largely unknown. Small colonies have been found in tree hollows or under loose bark and specimens have been collected from under house roofs and the metal caps on telegraph poles. It commonly roosts with other species of bats, including *Scotorepens orion* (Eastern Broad-nosed Bat) and *Chalinolobus gouldii* (Gould's Wattled Bat).

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21. *Miniopterus australis*

Little Bentwing-bat

This species inhabits tropical rainforest to warm-temperate wet and dry sclerophyll forest occurring along the coastal plains and adjacent ranges from Cape York to north-eastern NSW around the Hunter River. Its distribution within Australia becomes increasingly coastal towards the southern limit of its range in NSW.

It is a sub-canopy hunter with a preference for well-timbered areas but it is also known to hunt in clearings adjacent to forests. Prey items include crane flies, ants, moths and wasps. Flight characteristics include rapid movement with considerable manoeuvrability.

The species is a cave dweller that congregates in the summer months in maternity roost colonies and disperses during winter. In the southern part of their range they hibernate during winter but in the north they remain active throughout the year. Recorded roosts include caves, mines, stormwater drains, disused railway tunnels and houses. Mating, fertilisation and implantation occur in July to August, followed by a period of retarded embryonic development until mid-September. Pregnant females congregate in specified large nursery caves to rear their young. Births occur in December, when single young are born. It is often found to roost with the Large Bentwing-bat (*Miniopterus schreibersii*), and benefits from this larger species' ability to increase the roost temperature using metabolic heat. There is a huge nursery colony of 100,000 adult bats at Mt. Etna caves, in central Queensland.

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22. *Miniopterus schreibersii*

Large Bentwing-bat

The Large (or 'Common') Bentwing-bat may occur throughout the world. However, Parnaby (1992) notes that the Australasian populations are unlikely to be the same species that occurs outside this area. Within Australia, it is found across the coastal and near coastal areas of the north of the NT and WA and also down the east coast from Cape York to Adelaide on the coastal plains and adjacent ranges.

It is a cave (and similar man-made structures) roosting species that generally feeds above the forest canopy in wet and dry tall open forest, catching insects on the wing. However, the species has also been recorded utilising rainforest, monsoon forest, open woodland, paperbark forests and open grasslands. Moths are the main prey item. Flight is very fast and typically relatively level with swift shallow dives; the estimated flight speed is 50km per hour.

The species is known to migrate over large distances, apparently utilising different roosts for different seasonal needs. The pattern of movement varies with local climate and the dispersion of suitable roost sites. It hibernates over winter in the southern parts of its range and development of the embryo may be delayed over winter by lowering body temperature using roosts in the cooler areas of a cave. Pregnant females roost in large colonies in nursery caves. Birth generally occurs around December. Females cluster together in a roost that generally possesses a domed roof, which allows for the

retention of warm air which may also promote faster growth. The young can fly by 7 weeks and reach adult size and are weaned by 10 weeks. The mothers then leave the cave to disperse to their winter roosts and a few weeks later, usually in March, there is a mass exodus of juveniles. The maternity colony is deserted by April.

The longevity record for an Australian bat is from a pregnant female Large Bentwing-bat that was banded and recaptured 18 years later (she was again pregnant).

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23. *Scoteanax rueppellii*

Greater Broad-nosed Bat

The Greater Broad-nosed Bat occurs only along the eastern coastal strip of Queensland and NSW where it is restricted to the coast and adjacent areas of the Great Dividing Range. In NSW it extends as far south as the Bega Plain. They are only found at low altitudes (below 500m).

This species apparently feeds on large moths and beetles, and some small vertebrates, emerging just after sundown, flying slowly and directly at a height of 3-6 metres, deviating only slightly to catch larger insects. It is also predatory on vertebrates including other bats, and is a noted carnivore on other captured bats in bat traps. *S. rueppellii* is known to hunt along tree-lined creeks, the junction of woodland and cleared paddocks, and low along rainforest creeks. It may have a preference for wet gullies in tall timber country.

The species roosts mainly in tree hollows but it has also been found in the roof spaces of old buildings. Little is known of the reproductive cycle, but it is suggested that the species follows the typical Vespertilionid pattern. What is known is that females congregate in maternity colonies and single young are born in January, slightly later than the other Vespertilionid bats that share its range. Males appear to be excluded from the colony during the birthing and rearing of the young.

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24. *Litoria aurea*

Green and Golden Bell Frog

Litoria aurea was formerly known to inhabit the eastern seaboard of New South Wales and Victoria from Byron Bay through to the Gippsland Lake Region as well as highland sites (New England District, south-western slopes of N.S.W. and Monaro District). Recent literature indicates that the northern and southern

distribution limits have not changed, however, *L. aurea* is no longer found on sites above an altitude of 300m above sea level. This frog species inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. *L. aurea* is thought to be displaced from more established sites by other frog species thus explaining its existence on disturbed sites.

The Green and Golden Bell Frog is a summer breeder and voraciously cannibalistic. The males call from August through to January using a distinctive four part call: “crawk-awk, crawk, crok, crok”. The common name of *L. aurea* is derived from its body colouration described as being dull olive to bright emerald green above with blotches of brown or golden-bronze.

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