FIGURE 5 LOCATION OF SUBJECT SITE IN RELATION TO LOCAL WILDLIFE CORRIDORS

4

CONCLUSIONS AND RECOMMENDATIONS

4.1 OVERVIEW

This chapter evaluates if the proposed development will significantly impact on ecological processes and the conservation value of the subject site and adjoining areas, especially with respect to threatened and nationally-significant fauna species and their habitats. It also recommends ways in which impacts can be minimised or avoided.

The potential impacts that have been considered are grouped into the following categories:

- loss of native fauna habitat;
- impacts on wildlife corridors;
- impacts on threatened and migratory species;
- disturbance to native wildlife (e.g. noise and human activity).

Each of these impacts already exists on the subject site to a significant extent. However, each is discussed in detail below with respect to the proposed development.

4.2 IMPACTS

4.2.1 Loss of Fauna Habitat

Ninety-two (92) fauna species have been recorded on the subject site, Clarence Estuary Nature Reserve or along the adjoining stretch of the Clarence River. Purcell *et al*. (2005) did not differentiate between species observed on the subject site and the adjoining areas, whereas this was done in the fieldwork conducted on 26-27 October 2006. In this latter survey period, 34 species were recorded in the Clarence Estuary Nature Reserve (50.0% of total species recorded), 14 species in the Clarence River (20.6%) and 30 species on the subject site (44.1%).

The proposed development is unlikely to impact on fauna habitats in the Clarence Estuary Nature Reserve or adjoining areas of the Clarence Estuary provided that the recommendations listed in Section 4.3 of the present report are implemented.

The subject site is 5.74 ha in area, which is a highly modified landscape and a negligible proportion of the total amount of habitat available for native fauna in the locality and the broader Northern Rivers region. Much better quality habitat for native fauna occurs in the Clarence Estuary Nature Reserve, Yuraygir National Park and Broadwater National Park. Therefore, the proposed development is unlikely to significantly reduce the amount of habitat available to native fauna, either at a local or broader geographical level.

If possible, the three hollow-bearing trees on the subject site should be retained. However, if they are to be removed, then it is unlikely to result in a significant decline in the number of hollow bearing trees in the locality. As a precautionary measure, at least six nest boxes that are suitably designed for bat roosts be placed in appropriate locations within the subject site if the hollow-bearing trees are to be removed. An appropriately designed nest box (Franks & Franks, 2003) is shown in Appendix C.

4.2.2 Impacts on Wildlife Corridor

The subject site is not part of a wildlife corridor (see Section 3.4.2). Therefore, the proposed development will not impact on wildlife corridors within the region.

4.2.3 Impacts on Threatened Species

Three threatened bat species, the Grey-headed Flying-fox (*Pteropus poliocephalus*), East Coast Freetail-bat (*Mormopterus norfolkensis*) and Eastern Bentwing-bat (*Miniopterus schreibersii*) have been recorded on the subject site. Potential habitat also occurs for the following threatened species: Osprey (*Pandion haliaetus*), Hoary Wattle Bat (*Chalinolobus nigrogriseus*), Little Bentwing-bat (*Miniopterus australis*), Large-footed Mouse-eared Bat (*Myotis adversus*) and Greater Broad-nosed Bat (*Scoteanax ruepelli*).

Two threatened species, the Osprey and Pied Oystercatcher (*Haematopus longirostris*), have been observed in the section of the Clarence River that adjoins the subject site. Potential habitat also occurs for the following threatened species: Great Knot (*Calidris tenuirostris*), Broad-billed Sandpiper (*Limicola falcinellus*), Black-tailed Godwit (*Limosa limosa*), Terek Sandpiper (*Xenus cinereus*), Beach Stone-curlew (*Esacus neglectus*), Greater Sand Plover (*Charadrius leschenaultii*), Lesser Sand Plover (*Charadrius mongolus*) and Little Tern (*Sterna albifrons*).

One threatened species, the Mangrove Honeyeater (*Lichenostomus fasciogularis*) has been recorded in the Clarence Estuary Nature Reserve. Potential habitat also occurs for the following threatened species: Osprey, Wompoo Fruit-Dove (*Ptilinopus magnificus*), Rose-crowned Fruit-Dove (*Ptilinopus regina*), Glossy Black-Cockatoo (*Calyptorhynchos lathami*), White-eared Monarch (*Monarcha leucotis*), Barred Cuckoo-shrike (*Coracina lineata*), Spotted-tailed Quoll (*Dasyurus maculatus*), Common Planigale (*Planigale maculata*), Squirrel Glider (*Petaurus norfolcensis*), Black Flying-fox (*Pteropus alecto*), Grey-headed Flying-fox, Eastern Blossom Bat (*Syconycteris australis*), East Coast Freetail Bat, Hoary Wattle Bat (*Chalinolobus nigrogriseus*), Little Bentwing Bat, Eastern Bentwing-bat, Large-footed Mouse-eared Bat, Northern Long-eared Bat (*Nyctophilus bifax*) and Greater Broad-nosed Bat.

Seven-part tests in Appendix B conclude that the proposed development would not significantly impact on the status of any of these species or their habitats provided that the recommendations presented in Section 4.3 are implemented.

One nationally vulnerable fauna species (the Grey-headed Flying-fox) has been recorded on the subject site. Two nationally endangered fauna species (Swift Parrot, Regent Honeyeater) may very occasionally occur on the subject site as vagrants.

Under the EPBC Act, a nationally vulnerable species is significantly impacted on if a proposal is likely to:

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

The Grey-headed Flying-fox is a highly mobile species and the proposed development of the subject site would not hinder the movement of this species to the extent that a population would be fragmented. In the Northern Rivers region, this species congregates in areas where there is prolific flowering of Swamp Mahogany and/or Coast Banksia (*Banksia integrifolia*). Neither of these species occurs within the subject site.

Under the EPBC Act, a nationally endangered species is significantly impacted on if a proposal is likely to:

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

The Swift Parrot and Regent Honeyeater may occasionally feed on the nectar of eucalypts and other trees when these trees are flowering within the subject site. However, there are no limiting resources for these two species on the subject site.

4.2.4 Impacts on Migratory Species

Under the EPBC Act, a migratory species is significantly impacted on if a proposal will or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species; or

- result in invasive species that are harmful to the migratory species becoming established in an area of important habitat of the migratory species; or

- seriously disrupt the life cycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Migratory species listed under the EPBC Act that use or potentially use the subject site or adjoining habitat areas are identified in Section 3.3.4 of the present report.

The area of habitat that would be cleared from the subject site is a negligible amount of area available to these species. Therefore, the proposed development is unlikely to have a significant impact on the status of migratory species that use or potentially use the subject site.

The existing 20-m wide foreshore reserve between the river and the subject site will be retained and there is unlikely to be any direct impact by the proposed development on the foraging areas of shorebirds that are listed under the EPBC provided that adequate sediment, pollution and erosion controls are in place during the construction period.

There is potential for people using the existing beachfront near the subject site to disturb foraging shorebirds. However, this level and type of disturbance already exists through the current use of the Blue Dolphin Holiday Resort by people. The extent of human disturbance is not likely to increase significantly as a result of the proposed development provided the recommendations listed in Sections 4.3.1 and 4.3.2 are implemented.

4.2.5 Disturbance to Native Wildlife

Increased noise and human activity during the construction and use of the proposed facilities, may disturb some native fauna. However, this is likely to be a short-term impact because many species become habituated to such disturbances.

4.3 RECOMMENDATIONS

4.3.1 Subject Site

- **If possible, retain the three hollow-bearing trees on the subject site.** If these trees are to be removed or significantly pruned, then at least six nest boxes that are suitable for use by microchiropteran bats (see Appendix C) should be placed in mature trees that are to be retained.

- **Silt fences and sediment ponds should be appropriately placed around construction areas on the subject site** to prevent runoff of sediment and nutrient-enriched waters into the Clarence Estuary Nature Reserve and the Clarence Estuary. The effectiveness of these traps should be closely monitored during construction, ensuring that treated site run-off meets EPA guidelines.

- **Trees and other vegetation that are to be removed from the subject site for the proposed development should be conducted with minimal disturbance to the soil.**

- **If trees or bushes have to be cleared from the subject site, they should be checked for the presence of active nests of birds (that is, those nests containing fertile eggs or nestlings) and arboreal mammals (such as possums).** These plants should not be removed or pruned until animals that are nesting in them have completed their breeding cycle.

- **Trees or bushes that are cleared or pruned should be checked for animals before and after felling or pruning**. Injured animals should be taken to a local vet or the local wildlife rescue service should be notified.

- **Construction wastes will require appropriate management to prevent accidental discharge of chemicals, truck washings or other pollutants into waterways and vegetation on the subject site and in the Clarence Estuary Nature Reserve.**

4.3.2 Management Issues Relevant to the Clarence Estuary

- **Display an interpretative sign on the subject site,** preferably near the waterfront, which depicts the importance of the Clarence Estuary as habitat for shorebirds and other marine species.

- **Restrict the ownership of dogs and cats in the proposed development and other future developments along the Clarence River, and ban the walking of dogs along the river foreshore.** This will help minimise disturbance and possible mortality of shorebirds.

- **Discourage people from collecting crustaceans, molluscs and other benthic fauna from the mudflats adjacent to the subject site.** This would help ensure that there are adequate food supplies for shorebirds that forage on the mudflats and minimise human disturbance to these birds.

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Appendix A

Plates

Plate 1 Typical Landscape of Subject Site

Plate 2 Treed Area Near North-western Corner of Subject Site

Plates 3 to 5 Treed Areas Along River Foreshore: Northern End (Top), Midway (Middle) and Southern (Bottom) End of Subject Site's Foreshore Boundary.

Plate 6 View of River Foreshore At High Tide

Plate 7 Boundary Area Between Clarence Estuary Nature Reserve (background) and Subject Site (foreground)

Plate 8 Typical View of Habitat in Clarence Estuary Nature Reserve

Appendix A

Seven-part Tests of Significance

APPENDIX B
SEVEN-PART TESTS OF SIGNIFICANCE

INTRODUCTION

The Seven-Part Test is a standard set of questions devised by the Scientific Committee established under the *Threatened Species Conservation Amendment Act 2002.* The Test should be applied individually to all threatened species, populations and ecological communities and their habitats that are to be, or likely to be, on the site to be developed.

The results of a Seven-Part Test help determine the nature and significance of impacts of the proposed development or activity on threatened species, populations or ecological communities, or their habitats, and whether the preparation of *Species Impact Statement* (SIS) is required.

An SIS provides a more detailed assessment of threatened biota issues and proposes measures to manage and mitigate adverse impacts on the threatened species, populations or ecological communities, or their habitats, resulting from the proposal.

Appendix B provides Seven-part tests for the following threatened fauna in relation to the proposed development:

Bird Species:

- Osprey (*Pandion haliaetus*);
- Great Knot (*Calidris tenuirostris*);
- Broad-billed Sandpiper (*Limicola falcinellus*);
- Black-tailed Godwit (*Limosa limosa*);
- Beach Stone-curlew (*Esacus neglectus*);
- Pied Oystercatcher (*Haematopus longirostris*);
- Greater Sand Plover (*Charadrius leschenaultii*);
- Lesser Sand Plover (*Charadrius mongolus*); and
- Little Tern (*Sterna albifrons*).

Bat Species:

- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- East Coast Freetail Bat (*Mormopterus norfolkensis*);
- Hoary Wattle Bat (*Chalinolobus nigrogriseus*);
- Little Bentwing Bat (*Miniopterus australis*);
- Eastern Bentwing Bat (*Miniopterus schreibersii*);
- Large-footed Mouse-eared Bat (*Myotis adversus*); and
- Greater Broad-nosed Bat (*Scoteanax ruepellii*).

BIRD SPECIES

1. SPECIES PROFILES

Osprey (*Pandion haliaetus*)

The Osprey is a large, water-dependent bird of prey, distinctive in flight and when perched. Despite its wing-span of up to 1.7 m, it is noticeably smaller than the White-bellied Sea-eagle. In flight it can be recognised by its distinctly bowed wings that are dark brown above, and barred underneath, and with white underwing coverts. Perched, the upperparts are dark brown and the underparts are white. The female has a dark streaky collar. The head is mainly white with a blackish stripe through the eye.

Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.

Ospreys favour coastal areas, especially the mouths of large rivers, lagoons and lakes where they feed on fish over clear, open water.

They breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. Incubation of 2-3 eggs, usually by the female, is about 40 days. Female remains with young almost until they fly, usually after about nine weeks in the nest.

Threats to this species include:

- removal of large trees near the coast that could be used as nest sites;
- disturbances to water quality, such as from the disposal of treated effluent or stormwater runoff, that increases turbidity in feeding areas; and
- ingestion of fish containing discarded fishing tackle.

Great Knot (*Calidris tenuirostris*)

This species is a medium-sized bulky wader with a straight, dark-brown bill and yellowish-brown legs. It has a striped crown with an indistinct white eyebrow. Its upperparts are grey, with dark feather tips; its underparts are white. The rump is pure white, the tail is tipped with grey. Breeding plumage consists of darker upperparts with black and chestnut markings.

Great Knots occur within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. They are often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. In NSW, the species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith.

The species migrates to Australia from late August to early September, although juveniles may not arrive until October-November. Most birds return north in March and April, however some individuals may stay over winter in Australia. Individuals forage for food by methodically thrusting their bills deep into the mud to search for invertebrates, such as bivalve molluscs, gastropods, polychaete worms and crustaceans.

Threats to this species include:

- hydrological changes to inland lakes may modify or remove important areas of suitable habitat for those individuals that overwinter in in Australia; and
- tourism or agricultural developments that reduce coastal and inland habitat areas.

Broad-billed Sandpiper (*Limicola falcinellus*)

The Broad-billed Sandpiper is an uncommon, small, stint-like sandpiper reaching 18 cm in length. It is superficially like the more common Curlew Sandpiper, but smaller in size and with a smaller but distinctive, heavy bill that is longer than the head. The bill is initially straight and tapering, then downturned and flattened, remaining quite broad at the tip. This is its most important distinguishing feature. In non-breeding plumage, the forehead, crown, hind-neck and sides of neck are pale grey-brown, streaked black. The fore-neck and breast are pale grey-brown, with a fine dark streaking, and the underparts are mostly white. The head feathers have a snipe-like pattern, with two light stripes above the eyes and a dark median stripe.

Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW.

The species is an active forager, typically feeding by rapidly and repeatedly jabbing its bill into soft wet mud. Feeding also occurs while wading, often in water so deep that they have to submerge their heads and necks in order to probe the underlying mud. Their diet includes insects, crustaceans, molluscs, worms and seeds.

Individuals are strongly migratory and only mildly gregarious when not breeding. Large flocks are seldom recorded and birds are often either encountered alone or feeding with other waders such as Red-necked Stints or Curlew Sandpipers.

Threats to this species include:

- coastal habitats are being impacted as land continues to be cleared for residential, agricultural and tourism developments; and
- hydrological changes to estuaries and similar water bodies may modify or remove important areas of suitable habitat.

Black-tailed Godwit (*Limosa limosa*)

This is a large sandpiper reaching 44 cm long, with a wingspan of 63 - 75 cm. It has a distinctive long, straight bill that is pink with a black tip. The wing has a white wing-bar across the dark flight feathers, and white underwing coverts. There is a sharp demarcation between the white rump and the black tail. Legs are greenish-black, long and trailing. The non-breeding plumage, observed in Australia, is greyish-brown above and white below, and a grey breast. A broad white stripe is apparent on the underwing. The iris is brown. Most readily mistaken for the similar and more common Bar-tailed Godwits *Limosa lapponica*. Distinguishing features of the Black-tailed Godwit include the black tail in flight; longer, more pink, non-upturned bill; and non-streaked breast. Grey to rufous-chestnut coloured breeding plumage may be visible in some Australian birds just after arrival in spring, or prior to departure in autumn, and in some over-wintering birds.

The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia (Palaearctic) and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, the it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. The species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.

It is primarily a coastal species and is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works.

Black-tailed Godwits forage for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. They roost and loaf on low banks of mud, sand and shell bars and are frequently recorded in mixed flocks with Bar-tailed Godwits.

Threats to this species include:

- hydrological changes to inland lakes and estuaries may modify or remove important areas of suitable habitat for individuals remaining in Australia over winter; and
- tourism, residential or agricultural developments reducing coastal and inland habitat areas.

Terek Sandpiper (*Xenus cinereus*)

The Terek Sandpiper is a medium-sized wader. Individuals are greyish-brown above and white below, with some white on the outer tail feathers and a noticeable white bar on the tips of the secondaries. The species may be distinguished from other waders by its long, slender, upturned black bill, which is dull orange at the base, and its orange legs and feet.

It is a rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The

two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. The latter has been identified as nationally and internationally important for the species.

In Australia, Terek Sandpipers have been recorded on coastal mudflats, lagoons, creeks and estuaries. They favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. They generally roost communally amongst mangroves of dead trees, often with related wader species.

Threats to this species include:

- clearing of habitat for residential, agricultural and tourism developments:
- hydrological changes to estuaries and similar waterbodies may modify or remove important areas of suitable habitat; and
- disturbance of foraging and roosting sites by nearby development or recreational activities.

Beach Stone-curlew (*Esacus neglectus*)

The Beach Stone-curlew is a large, thick-set wader, reaching 56 cm in length, with a wingspan of up to 1 m. Adults have a large head, massive uptilted bill, hunched profile, stout legs and thick 'knees'. The upper body is predominantly grey-brown, with distinctive black and white patterning on the face and shoulder. The throat and breast are a paler grey and the belly white. The wings are mostly white with black tips. During the night, breeding birds give a harsh, wailing territorial call, which is higher pitched, harsher and less fluty than that of the Bush Stone-curlew (*Burhinus grallarius*).

The Beach Stone-curlew has been recorded around the north coast of Australia, mainly between mid-north Western Australia and north-east NSW. The species has largely disappeared from the south-east of its former range and is now rarely recorded on ocean beaches in NSW.

It occurs on open, undisturbed beaches, islands, reefs, and estuarine intertidal sandflats and mudflats; beaches with estuaries or mangroves nearby are preferred; may also frequent river mouths, offshore sandbars and rock platforms.

Breeding occurs from September to November, with nests being located on sandbanks, spits or islands in estuaries, among mangroves, or in sand surrounded by short grasses and scattered casuarinas.

Threats to this species include:

- loss of habitat due to urban and industrial development;
- nest disturbance which can lead to nest desertion through beach-combing, dog-walking, boating and 4WD vehicles;
- predation by raptors, ravens, cats, domestic dogs and foxes; and
- nest destruction by pigs.

Pied Oystercatcher (*Haematopus longirostris*)

The Pied Oystercatcher is an unmistakable, large, black and white wader, reaching 50 cm in length. The sexes are similar, yet may be separable when together with the female having a slightly longer, more slender bill. When not in flight, the Pied Oystercatcher appears entirely black above, with white underparts. The back, head and breast are black, and the belly, rump and tail are white. The tail is tipped black. The wings are black with a narrow white bar on the upperwing and white underwing coverts. The eye-ring, iris and bill of the Pied Oystercatcher are brilliant scarlet and its legs are stout and coral pink. The most often heard call is a loud, sharp, high-pitched 'kurvee-kurvee-kurvee', usually given in alarm, which increases in pitch and rapidity when a nest site is approached.

The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast.

Pied Oystercatchers favour intertidal flats of inlets and bays, open beaches and sandbanks. They forage on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish.

They nest mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.

Threats to this species include:

- disturbance to coastal feeding, nesting and roosting areas through beach-combing, fishing, dog-walking, horse-riding and 4WD vehicles;
- predation of eggs and chicks by foxes, dogs, cats, Australian Ravens and raptors;
- habitat destruction as a result of residential, agricultural and tourism developments; and
- hydrological changes to estuaries and similar water bodies causing modification or removal of important areas of suitable habitat.

Greater Sand-Plover (*Charadrius leschenaultii*)

The non-breeding plumage of the Greater Sand-Plover has a grey-brown crown, nape, back and breast patches. The lores, bill and upperwing are dark, with dusky ear-coverts. There is prominent white plumage on the forehead, chin, throat and underparts, including the underwing. The legs and feet are greenish-grey; this helps distinguish it from the very similar Lesser Sand-Plover, with dark grey legs. Birds have a hunched, horizontal stance when relaxed, and a more upright extended stance when alert. When breeding in the Northern Hemisphere, the plumage on the breast, crown and nape changes to a dull brick-red and the ear coverts become black. Elements of this plumage may be visible in some Australian birds just after arrival in spring or prior to departure in autumn, and in some over-wintering birds.

The Greater Sand-Plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, being found usually singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries.

It is almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Individuals roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.

The diet includes insects, crustaceans, polychaete worms and molluscs. Prey is detected visually by running a short distance, stopping to look, then running to collect the prey.

Threats to this species include:

- loss and degradation of habitats as a result of residential, agricultural and tourism developments; and
- hydrological changes to estuaries and similar water bodies may modify or remove important areas of suitable habitat.

Lesser Sand-Plover (*Charadrius mongolus*)

The non-breeding Lesser Sand-Plover has a grey-brown crown, nape, back and breast patches. The forehead, lores, bill and upperwing are dark; ear coverts are dusky. There is prominent white plumage on the forehead, chin, throat and underparts, including the underwing. The Lesser Sand-Plover is distinguished from the Greater Sand-Plover by a smaller body with a more upright stance, more compact appearance and dark grey, rather than greenish legs. When breeding in the Northern Hemisphere, the plumage on the breast, crown and nape changes to a dull brick-red and the ear coverts become black. The brick-red breast is separated from the white throat by a narrow black line. Elements of this plumage may be visible in some Australian birds just after arrival in spring or prior to departure in autumn, and in some over-wintering birds.

The Lesser Sand-Plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records.

This species is almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. It is highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. It roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.

The diet includes insects, crustaceans, molluscs and marine worms. Prey is usually detected visually, with the birds making short, quick runs, with abrupt stops to lunge at the ground or look for prey.

Threats to this species include:

- loss and degradation of habitats as a result of residential, agricultural and tourism developments; and
- hydrological changes to estuaries and similar water bodies may modify or remove important areas of suitable habitat.

Little Tern (*Sterna albifrons*)

The Little Tern is a small, slender, migratory or partly migratory seabird. At less than 25 cm long it is two- thirds to half the size of any other south-eastern tern. Pale grey upperparts contrast with the white chest, underbelly and the moderately long, deeply forked tail (80 - 110 mm). The Little Tern has a black cap and black outer wing-edges. During breeding the bill (26 - 32 mm) and legs change from black to yellow, and a black wedge appears from the bill to the eye. During non-breeding, the Little Tern's black cap shrinks to a black nape and its bill becomes black.

Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months.

The Little Tern is almost exclusively coastal, preferring sheltered environments; however it may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records).

It nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. The nest is a scrape in the sand, which may be lined with shell grit, seaweed or small pebbles. Both parents incubate up to three well-camouflaged eggs for up to 22 days, aggressively defending the nest against intruders until the young fledge at 17 - 19 days.

It is often seen feeding in flocks, foraging for small fish, crustaceans, insects, annelids and molluscs by plunging in the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight.

Threats to this species include:

- nesting at flood-prone locations;
- predation of eggs and chicks by foxes, dogs, cats, black rats, silver gulls, ravens and raptors;

- disturbance to coastal feeding, nesting and roosting areas through beach-combing, fishing, dog-walking, horse-riding and 4WD vehicles; parents often leave the nest when approached, resulting in exposure of chicks or eggs;
- coastal and inland habitat areas are being impacted by land clearing for residential, agricultural and tourism developments, by sand and rutile mining, and by waste disposal dumps;
- hydrological changes to estuaries and similar waterbodies may modify or remove important areas of suitable habitat, or affect the availability of food;
- potentially susceptible to pesticides and contamination of estuaries by oil-spills and heavy metals; and
- well-camouflaged eggs are at risk of accidental destruction.

2. SEVEN-PART TEST

(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.

Osprey

In the Northern Rivers Catchment Management Area (CMA), Ospreys are known to occur in the following CMA Sub-regions: Clarence Lowlands, Clarence Sandstones, Coffs Harbour and Escarpment, Macleay Hastings, Murwillumbah (Qld to Southeast Hills and Ranges), Northern Rivers (marine zone), Richmond-Tweed (Qld to Scenic Rim) and Yuraygir. The Osprey that has been observed foraging in the Clarence Estuary, near the subject site, is probably part of this larger population.

Some mature remnant trees on the subject site will be removed or pruned as a result of the proposed development (see Figure 4). Mature trees on the subject site, especially those trees that occur along the river foreshore, are potential nesting and/or perching trees for Ospreys. However, it is unlikely that Ospreys would use these trees because of ongoing human disturbances that result from the current use of the site as a holiday resort. Therefore, the local Ospreys are more likely to use trees within the Clarence Estuary Nature Reserve or on Dart and Hickey Islands where there is much better quality nesting and perching habitat.

The proposed development will not significantly impact on the quality of Osprey foraging habitat within the Clarence River.

Therefore, the proposed development will not have an adverse effect on the life cycle of the Osprey to the extent that a viable local population is likely to be placed at risk of extinction.

Migratory Shorebirds

No threatened migratory shorebirds (Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Terek Sandpiper, Greater Sand Plover and Lesser Sand Plover) were observed on the Clarence River mudflats, despite targeted surveys for them around low tide. However, these mudflats are potential foraging grounds for these species.

Individuals of each species that have been recorded in the locality are likely to be part of one population of their respective species that disperse across Australia during their non-breeding period. Estimates of the Australian population sizes of each migratory shorebird are provided by Watkins (1993).

The estimated size of the Australian population of Great Knots is 319,000 birds. Most Great Knots are concentrated on the coastal mudflats of north-western Australia, the Northern Territory and the Gulf of Carpentaria. There are no areas in NSW known to contain high concentrations of Great Knots.

The estimated size of the Australian population of the Broad-billed Sandpiper is 8,000 birds. Known areas of greatest concentrations of this species in Australia are the Port Hedland Saltworks in WA (6,000 birds) and the mudflats of South-east Gulf of Carpentaria in Qld (1,740 birds), the Hunter Estuary in NSW (180 birds) and Roebuck Bay in WA (110 birds).

The estimated size of the Australian population of the Black-tailed Godwit is 81,000 birds. In Australia, this species is concentrated on the northern coast between Darwin and Weipa. The most important site in the Gulf of Carpentaria is the mudflat area north and west of Karumba (49,400 birds). There are no sites in NSW that are known to provide habitat for large concentrations of Black-tailed Godwits.

The estimated size of the Australian population of the Terek Sandpiper is 18,000 birds. Known areas of greatest concentrations of this species in Australia are Eighty Mile Beach in WA (6,000 birds), South-east Gulf of Carpentaria in Qld (2,800 birds), Great Sandy Strait in Qld (2,494 birds), Roebuck Bay in WA (1,000 birds) and the Hunter Estuary in NSW (600 birds).

The estimated size of the Australian population of the Greater Sand Plover is 74,000 birds. Known areas of greatest concentrations of this species in Australia are Eighty Mile Beach in WA (30,400 birds), Roebuck Bay in WA (26,900 birds), the South-east Gulf of Carpentaria (4,160 birds) and the Darwin area in the NT (1,024 birds). There are no sites in NSW that are known to provide habitat for large concentrations of Greater Sand Plovers.

The estimated size of the Australian population of the Lesser Sand Plover is 20,000 birds. The greatest concentrations of these species in Australia are along the northern coastline (1,057 birds in Roebuck Bay in WA to 4,050 birds in the South-east Gulf of Carpentaria in Qld. Relatively large concentrations of this species are known from six sites in NSW: Hunter Estuary (800 birds), Tuggerah Lakes (510 birds), Clarence Estuary (304 birds), Richmond Estuary (250 birds), Shoalhaven Estuary (250 birds) and Botany Bay (204 birds).

Therefore, the mudflats adjacent to the subject site are not critical to the survival of Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Terek Sandpiper and Greater Sand Plover populations. However, they are potentially important as foraging habitat for the Lesser Sand Plover.

Pied Oystercatcher

Two Pied Oystercatchers were observed foraging on the mudflats adjacent to the subject site on 26 October 2006. This species was also recorded in September 2005 by Purcell *et al*. (2005). These individuals are likely to be part of a population that is thinly scattered along the entire NSW coastline.

There are no reliable estimates of the number of Pied Oystercatchers along the NSW coastline. There are an estimated 10,000 Pied Oystercatchers around the Australian coastline. Therefore, it is likely that the Pied Oystercatchers observed during the present study are a negligible proportion of a local viable population and the mudflats that are adjacent to the subject are a negligible proportion of potential habitat for this species.

Beach Stone-curlew

No Beach Stone-curlews were observed in the Clarence Estuary during the present study, but potential foraging habitat occurs on the mudflats adjacent to the subject site. Beach Stone-curlews that have been recorded in the locality are likely to be members of a population that extends along the northern coastline of Australia from Coffs Harbour, NSW in the south to Pt Cloates in north-western WA. Therefore, the mudflats adjacent to the subject site represent a negligible proportion of the total potential habitat available to this population.

Watkins (1993) estimates the Australian population to be 1,000 individuals, but Garnett & Crowley (2000) indicate that there are a further 50-70 birds on the northern Great Barrier Reef and an unknown, but probably substantial, number along the coasts of the NT and WA.

Little Tern

No Little Terns were observed in the Clarence Estuary during the present study, but they may feed in the deeper waters of the estuary. Little Terns that have been recorded in the locality are likely to be members of the eastern Australian population that occurs along the coastlines of Tasmania, Victoria, NSW, and Qld north to about Elliott River (20ºS) (Higgins & Davies 1996). Therefore, the mudflats adjacent to the subject site represent a negligible proportion of the total potential habitat available to this population.

The total breeding population in eastern Australia was estimated to be 310-319 pairs in December 1989: 3,178 birds (including 56 breeding pairs) in Qld, 1,134 birds in NSW (including 80 or 87 breeding pairs in NSW), 314 birds in Victoria (including a minimum of 155 breeding pairs) and 29 birds in Tasmania (including at least 6 breeding pairs) (Higgins & Davies 1996).

Potential Impacts on Shorebirds

The existing 20-m wide foreshore reserve between the river and the subject site will be retained and there is unlikely to be any direct impact by the proposed development on the foraging areas of shorebirds provided that adequate sediment, pollution and erosion controls are in place during the construction period.

There is potential for people using the existing beachfront near the subject site to disturb foraging migratory shorebirds. However, this level and type of disturbance already exists through the current use of the Blue Dolphin Holiday Resort by people. The extent of human disturbance is not likely to increase significantly as a result of the proposed development.

The following measures are recommended to minimise the impacts of the proposed development on foraging habitat of shorebirds in the Clarence Estuary:

- Display an interpretative sign on the subject site, preferably near the waterfront, which depicts the importance of the Clarence Estuary as habitat for shorebirds and other marine species.
- Restrict the ownership of dogs and cats in the proposed development and other future developments along the Clarence River, and ban the walking of dogs along the river foreshore. This will help minimise disturbance and possible mortality of shorebirds.
- Discourage people from collecting crustaceans, molluscs and other benthic fauna from the mudflats adjacent to the subject site. This would help ensure that there are adequate food supplies for shorebirds that forage on the mudflats and minimise human disturbance to these birds.

The proposed development will not have an adverse effect on the life cycle of threatened shorebird species to the degree that it is likely to place local owl populations at risk of extinction, provided that the above-mentioned recommendations are implemented.

(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.

Not applicable. The Osprey and shorebird species are threatened species and not endangered populations.

(c) In the case of an endangered ecological community or critically 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
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable. The Osprey and shorebird species are not endangered or critically endangered ecological communities.

(d) In relation to a habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(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
(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.

(i) Some mature remnant trees on the subject site (potential nest or perching trees of the Osprey) will be removed or pruned as a result of the proposed development (see Figure 4).

There will be no removal or modification of foraging habitat for the Osprey or shorebirds as a result of the proposed development.

(ii) The proposed development will not result in fragmentation or isolation of threatened bird habitat.

(iii) Mature trees on the subject site, especially those trees that occur along the river foreshore, are potential nesting and/or perching trees for Ospreys. However, it is unlikely that Ospreys would use these trees because of ongoing human disturbances that result from the current use of the site as a holiday resort. Therefore, the local Ospreys are more likely to use trees within the Clarence Estuary Nature Reserve or on Dart and Hickey Islands where there is much better quality nesting and perching habitat.

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

No critical habitat for threatened bird species occurs in the locality.

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

Osprey

The priority actions for the protection of the Osprey in NSW are stated below:

1. Consider direct and indirect impacts on the species and its habitat in planning processes including adequate field survey to identify nest tree, buffer protection zone, perch trees and feeding areas. Nesting season is from June to October (High priority).

2. Continue ecological research to determine whether availability of potential nest trees and/or food resources are limiting to the species as well as potential impacts of pesticides and polluntants on species breeding success (Medium priority).

3. Continue programs monitoring the breeding status of the species in NSW incorporating surveys of the number of active nest trees, breeding success at nests and protection of buffer zones and roost trees (High priority).

4. Continue the preparation of the Osprey recovery plan, taking into account and updating the former NPWS plan "The biology and management of the Osprey in NSW" (NPWS 1991) (Medium priority).

5. Continue to consult with Aboriginal communities to determine cultural significance of the osprey (High priority).

6. Identify and protect regular feeding areas, perch (feeding) trees and nest material collection sites, particularly vegetation surrounding nest tree (High priority).

7. Investigate the effectiveness of ameliorative management actions on the species including effectiveness of artificial nest structures (Medium priority).

8. Protect nest sites (usually large dead trees) and surrounding vegetation using appropriate

buffer zones (suggest 100 metres). Preservation of the existing nest and structure is a priority and relocation should only be considered a last resort (High priority).

9. Undertake community awareness initiatives such as media campaigns, brochures and interpretive signs. These should cover issues such as the threat of discarding fish with fishing tackle attached, protection of potential and future nest trees (Medium priority).

The proposed development is consistent with the priority actions for the recovery of the Osprey in NSW.

Migratory Shorebirds
(Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Terek Sandpiper, Greater Sand Plover and Lesser Sand Plover)

The priority actions for the protection of migratory shorebirds in NSW are stated below:

1. Increase community awareness and understanding of migratory waders via promotion of the DEC threatened species website and other educational materials (eg. signage, brochures) and through the use of media (Low priority).

2. Minimise human disturbance at identified key foraging sites (disturbance from 4WDs, recreational users, dog-walkers, fishermen etc.) (Medium priority).

3. Review survey data to identify key foraging sites for each shorebird species along the NSW coast (Medium priority).

4. Undertake regular 2-yearly coordinated survey to assess the distribution and population size of each shorebird species (Medium priority).

The proposed development is consistent with the priority actions for the recovery of the Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Terek Sandpiper, Greater Sand Plover and Lesser Sand Plover in NSW.

Beach Stone-curlew

The priority actions for the protection of the Beach Stone-curlew in NSW are stated below:

1. All records of *E. neglectus* should be submitted to the Atlas of NSW Wildlife (High priority).

2. Assess the potential impact of climate change and sea-level rise on *E. neglectus* habitat and identify potential mitigation strategies (Medium priority).

3. Control vegetation at nest, shelter and foraging sites that reduce site quality for *E. neglectus* (High priority).

4. Design a public awareness campaign targeting beach users on the impact of dogs, vehicles, and human access to *E. neglectus* sites (High priority).

5. Develop a Code of Conduct for beach users including clubs to minimise impact of human disturbance on *E. neglectus* sites (High priority).

6. Develop and implement threat management strategies for priority sites (High priority).

7. Do not construct river training walls on Corindi River, southern side of Nambucca River or the entrance to Farquhar Inlet (High priority).

8. Engage local Indigenous communities in the survey, monitoring and protection of *E. neglectus* sites (Medium priority).

9. Implement programs to increase freshwater environmental flows into estuarine systems (High priority).

10. Improve protection from disturbance of sites in the Corindi, Sandon and Wooli estuaries (High priority).

11. Monitor key habitat sites to identify changes in habitat structure that may influence use by *E. neglectus* (High priority).

12. Prepare and distribute EIA guidelines to consent authorities (Medium priority).

13. Prevent dredging of large intertidal sandflats in the vicinity of *E. neglectus* habitat (High priority)

14. Protect foraging and roosting sites within the Bellinger, Tweed and Shoalhaven estuaries (Medium priority).

15. Protect foraging and roosting sites within the Clarence, Nambucca and Manning River (Farquarh Inlet) Estuaries on Crown land (High priority).

16. Support programs to improve water quality in floodplain drains and improve quality of flood flows (High priority).

17. Undertake fox control programs as per the Fox TAP (High priority).

18. Undertake research on habitat utilisation and foraging ecology (Medium priority).

19. Undertake research on the impact of human recreation and other threats on *E. neglectus* (High priority).

20. Undertake statewide population survey every five years to identify population and distribution trends and to review management priorities (High priority).

The proposed development is consistent with the priority actions for the recovery of the Beach Stone-curlew in NSW.

Pied Oystercatcher

The priority actions for the protection of the Pied Oystercatcher in NSW are stated below:

1. Avoid disturbance of nesting sites from lake and estuary openings during breeding season (Medium priority).

2. Control of native predators at breeding sites as required (Medium priority).

3. Declare nesting habitat as wildlife protection areas under Companion Animal Management Plans and exclude uncontrolled dogs from such areas, particularly in the breeding season (Medium priority).

4. Design a survey and monitoring program (Medium priority).

5. Develop, finalise and implement the Threatened Species (Pied Oystercatcher) Management Strategy in the Richmond River Area (High priority).

6. Employ regionally-based Shorebird Recovery Coordinators (High priority).

7. Implement fox control around identified nesting habitat as per the NSW Fox TAP (High priority).

8. Involve trained community volunteers in survey, monitoring and wardening (Medium priority).

9. Maintain the South Coast Shorebird Recovery Team and statewide coordination forums (Medium priority).

10. Prepare estuary management plans that identify and protect nesting habitat (Medium priority).

11. Provide local managers and community groups with materials for protection of nesting sites (High priority).

12. Provide results of annual survey and monitoring to coastal councils (Medium priority).

13. Undertake annual survey and monitoring of distribution, numbers and breeding success (flying young) (High priority).

14. Undertake multi-media program of community awareness (Medium priority).

The proposed development is consistent with the priority actions for the recovery of the Pied Oystercatcher in NSW.

Little Tern

The priority actions for the protection of the Little Tern in NSW are stated below:

1. Acquire Little Tern nesting sites for inclusion in reserves (Medium priority).

2. Control encroaching vegetation, to allow for suitable nesting habitat, as part of the intensive management of nesting, resting and fledgling feeding sites (High priority).

3. Control feral predators (including rats, cats and foxes) as part of the intensive management of nesting, resting and fledgling feeding sites (High priority).

4. Control native predators as part of the intensive management of nesting, resting and fledgling feeding sites (High priority).

5. Discourage nesting in unfavourable sites, including protection from nest inundation/flooding, as part of the intensive management of nesting, resting and fledgling feeding sites (High priority).

6. Employ recovery coordinators on south coast and investigate feasibility for coordinators in other areas (Medium priority).

7. Encourage interest groups to participate in the survey and monitoring of Little Terns at active nesting sites (Medium priority).

8. Identify knowledge gaps to promote research opportunities that guide future management actions, identify problems and gauge success of recovery actions (Medium priority).

9. Inform and consult with land managers (including state and local government authorities and community groups with responsibilities relevant to the protection of Little Terns and their habitats) (Medium priority).

10. Investigate the cultural and historic significance of the Little Tern (Medium priority).

11. Investigate the potential for the creation of island nesting sites using dredge spoil (Medium priority).

12. Involve community groups in the protection and management of Little Tern nesting habitat (Medium priority).

13. Maintain statewide coordination of the approved Little Tern recovery plan (Low priority).

14. Maintain the Little Tern recovery team for the duration of the current approved plan (until 2008) (Low priority).

15. Minimise disturbance to nesting sites from lake and estuary openings (Medium priority).

16. Minimise human disturbance (including 4WD activities, and dogs being walked) as part of the intensive management of nesting, resting and fledgling feeding sites (High priority).

17. Organise a biennial debrief session to provide a forum to exchange ideas to improve management of the Little Tern across NSW (Medium priority).

18. Produce a Little Tern Field Manual, to achieve best practice in terms of the management of Little Tern breeding colonies (Medium priority).

19. Train site wardens to undertake site management at each priority nesting site (High priority).

20. Undertake analysis of monitoring data and preparation of status report of Little Terns at

all sites in NSW (High priority).

21. Undertake annual monitoring of individual colonies (sites will vary year to year) (High priority).

22. Undertake banding studies of Little Terns (to complement other survey and monitoring actions) to improve knowledge on distribution of species (Medium priority).

The proposed development is consistent with the priority actions for the recovery of the Little Tern in NSW.

(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.

The proposed development is not part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process on threatened bird species provided that the recommendations presented in Point (a) are implemented.

3. CONCLUSION

There are not likely to be any significant impacts on the status of the Osprey, Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Terek Sandpiper, Greater Sand Plover and Lesser Sand Plover, Pied Oystercatcher, Beach Stone-curlew or Little Tern resulting from the proposed development. Therefore, a Species Impact Statement is NOT required for these species.

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BATS

1. SPECIES PROFILES

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

Historically, Grey-headed Flying-foxes had a greater range in Australia and numbers were estimated as being in the millions. Counts of flying-foxes over the past decade suggest that the national population may have declined up to 30% (Birt 2000; Richards 2000). Regular visits to flying-fox camps during this period have shown a marked decline in the numbers using these camps (Eby 2000; Parry-Jones 2000). It has also been estimated that the population will continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss and culling (Martin 2000).

This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, *Melaleuca* swamps and *Banksia* woodlands. It plays an important ecosystem function by providing a means of seed dispersal and pollination for many indigenous tree species (Eby 1996; Pallin 2000). The species also feed on introduced trees including commercial fruit crops.

Grey-headed Flying-foxes congregate in large numbers at roosting sites (camps) that may be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban and rural areas. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring (Lunney & Moon 1997; Augee & Ford 1999). They forage opportunistically, often at distances from camp of up to 60-70 km per night, in response to patchy food resources (Augee & Ford 1999).

Grey-headed Flying-foxes show a regular pattern of seasonal movement. Much of the population concentrates in May and Junes in northern NSW and Queensland where animals exploit winter-flowering trees such as Swamp Mahogany *Eucalyptus robusta*, Forest Red Gum *E. tereticornis* and Paperbark *Melaleuca quinqernervia* (Eby *et al*. 1999). Food availability, particularly nectar flow from flowering gums, varies between places and from year to year.

Movement patterns of Grey-headed Flying-foxes are also irregular and unpredictable towards the edges of their distributional range. For instance, it appears that numbers in Victoria are highest in years when flowering of eucalypts in the coastal forests of southern NSW is poor. Conversely, in years when flowering in southern NSW is prolific, the number visiting Victoria is very low (Aston 1987; Parry-Jones 1987).

Grey-headed Flying-foxes are relatively long-lived mammals, with a generation length of six to 10 years. They have a low rate of reproduction because sexual maturity is reached after at least three years and generally only one offspring is produced each year (Martin *et al*. 1996).

Although mating can be observed throughout the year, males are apparently fertile only for a short period during March and April, and breeding is highly seasonal (Nelson 1965a; Martin *et al*. 1987).

Gestation lasts about six months and mot females give birth to a single young each September or October. For the first four or five weeks of life they cling to their mothers' belly fur. For a further 12 weeks young are flightless and are left in the camp while their

mother forages and are suckled on return. Young are weaned at five or six months (Martin *et al*. 1987). At the end of summer food becomes scarce and the large camps break up. Many adults then lead a dispersed nomadic existence (Nelson 1965a,b), but others travel hundreds of kilometres to congregate at winter camps near reliable food supplies.

The main threat to Grey-headed Flying-foxes in NSW is the clearing or modification of native vegetation. This removes appropriate camp habitat and limits the availability of natural food resources, particularly winter feeding habitat in north-eastern NSW. The urbanisation of coastal plains of south-eastern Queensland and northern NSW has seen the removal of critical feeding sites, and this threatening process continues (Catterall *et al*. 1997; Pressey & Griffith 1992).

The use of non-destructive deterrents, such as netting and noise generators, to limit flying-fox damage to fruit crops is not universal in the horticultural industry. While licences are issue to cull limited numbers of Grey-headed Fly-foxes, uncontrolled culling using destructive methods such as shooting and electrocution occurs and large numbers of bats are culled (Vardon & Tidemann 1995; Richards 2000). The impacts of destructive methods has not been measured, but is greatest when natural food is scarce. Also, culling has a disproportionate impact on lactating and pregnant females (Parry-Jones 1993).

The species is also threatened by direct harassment at roosts, the destruction of their camps and by being possible carriers for viral pathogens (Tidemann 1999).

Grey-headed Flying-foxes face potential competition and hybridisation from Black Flying-foxes (Pteropus alecto), because this latter species is extending its range south in to northern NSW (Webb & Tidemann 1995).

East Coast Freetail Bat (*Mormopterus norfolkensis*)

The Eastern Freetail-bat has dark brown to reddish brown fur on the back and is slightly paler below. Like other freetail-bats it has a long (3 - 4 cm) bare tail protruding from the tail membrane. Freetail-bats are also known as mastiff-bats, having hairless faces with wrinkled lips and triangular ears. They weigh up to 10 grams.

The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures. It is a solitary and is probably insectivorous.

Threats to this species include:

- loss of hollow-bearing trees;
- loss of foraging habitat; and
- application of pesticides in or adjacent to foraging areas

Hoary Wattled Bat (*Chalinolobus nigrogriseus*)

The Hoary Wattled Bat is a small sooty-coloured bat with a light silvery-white frosting or hoary appearance at close quarters. As also suggested by its name, there are small lobes of skin or wattles between the ears and mouth. This bat is typically observed flying about at dusk, leaving its roost site before other bat species have emerged.

This species is distributed widely across northern Australia although absent from the arid centre. In north east NSW it reaches the lower Clarence and Richmond River areas, extending from near Murwillumbah in the north, south to between Grafton and Coffs Harbour.

In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat.

Threats to this species include:

- clearing and fragmentation of dry forest and woodland habitat through clearing for agriculture and development;
- loss of hollow-bearing trees used for roosting and maternity sites, usually as a result of too-frequent burning and forest management favouring younger stands; and
- use of pesticides.

Little Bentwing Bat (*Miniopterus australis*)

Little Bentwing-bats are small chocolate brown insectivorous bats with a body length of about 45 mm. The fur is long and thick, especially over the crown and around the neck. The tip of the wing is formed by a particularly long joint of the third finger.

This species occurs in moist eucalypt forest, rainforest or dense coastal banksia scrub in coastal north-eastern NSW and eastern Queensland.

Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Common Bentwing-bats (*M. schreibersii*) and appears to depend on the large colony to provide the high temperatures needed to rear its young.

Threats to this species include:

- disturbance of colonies, especially in nursery or hibernating caves may be catastrophic;
- destruction of caves that provide seasonal or potential roosting sites;
- changes to habitat, especially surrounding maternity caves; and
- use of pesticides.

Eastern Bentwing Bat (*Miniopterus schreibersii*)

The Eastern Bent-wing Bat has chocolate to reddish-brown fur on its back and slightly lighter coloured fur on its belly. It has a short snout and a high 'domed' head with short round ears. The wing membranes attach to the ankle, not to the base of the toe. The last bone of the third finger is much longer than the other finger-bones giving the "bent wing" appearance. It weighs up to 20 grams, has a head and body length of about 6 cm and a wingspan of 30 - 35 cm.

This species occurs along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.

Individuals form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Breeding or roosting colonies can number from 100 to 150,000 individuals. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia.

Individuals hunt in forested areas, catching moths and other flying insects above the tree tops.

Threats to this species include:

- damage to or disturbance of roosting caves, particularly during winter or breeding;
- loss of foraging habitat;
- application of pesticides in or adjacent to foraging areas; and
- predation by feral cats and foxes.

Large-footed Mouse-eared Bat (*Myotis adversus*)

This species is now most often referred to as *Myotis macropus* or the Southern Myotis. It has disproportionately large feet; more than 8 mm long, with widely-spaced toes which are distinctly hairy and with long, curved claws. It has dark-grey to reddish brown fur above and is paler below. It weighs up to 15 grams and has a wingspan of about 28 cm.

The Large-footed Mouse-eared Bat is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers.

Individuals generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. They forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.

Threats to this species include:

- Reduction in stream water quality affecting food resources
- Loss or disturbance of roosting sites.

- Clearing adjacent to foraging areas.
- Application of pesticides in or adjacent to foraging areas.

Greater Broad-nosed Bat (*Scoteanax ruepellii*)

The Greater Broad-nosed Bat is a large powerful bat, up to 95 mm long, with a broad head and a short square muzzle. It is dark reddish-brown to mid-brown above and slightly paler below. It is distinguished from other broad-nosed bats by its greater size. While similar to the Great Pipistrelle *Pipistrellus tasmaniensis*, it differs by having only two (not four) upper incisors.

The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m.

This species occurs in a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although Greater Broad-nosed Bats usually roost in tree hollows, they have also been found in buildings.

It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.

Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.

Threats to this species include:

- disturbance to roosting and summer breeding sites;
- foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions;
- loss of hollow-bearing trees;
- pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores; and
- changes to water regimes are likely to impact food resources, as is the use of pesticides and herbicides near waterways.

2. SEVEN-PART TEST

(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.

Grey-headed Flying-fox

There are no roosting colonies (camps) of Grey-headed Flying-foxes on the subject site or in neighbouring bushland. In the Northern Rivers area, Grey-headed Flying-foxes tend to congregate in areas where there is a concentration of Swamp Mahoganies (*Eucalytpus robusta*) and Old Man Banksias (*Banksia serrata*), which are favoured food trees of the species. Neither tree species occurs on the subject site and are not in high concentrations in adjoining areas.

Therefore, the proposed development is unlikely to have an adverse effect on the life cycle of the Grey-headed Flying-fox such that a local population of this species is likely to be placed at risk of extinction.

Microbats Dependent on Tree Hollows
(East Coast Freetail-bat, Hoary Wattled Bat, Large-footed Mouse-eared Bat & Greater Broad-nosed Bat)

One threatened bat species that is dependent on tree hollows, the East Coast Freetail-bat, was recorded on the subject site. The site provides potential roosting and foraging habitat for the other hollow-dependent microbat species.

Only three trees on the subject site were observed with hollows that are large enough to be used as roosting and breeding habitat and shelter by microchiropteran bats. Two of these trees were Broad-leaved Paperbarks outside Cabin DV 5 (see Figure 3 for location) and the third hollow-bearing tree was a mature Coast Banksia, which was located mid-way along the river foreshore reserve.

The scarcity of tree hollows on the subject site is due largely to past habitat clearance, and removal of some limbs and branches from existing trees on the subject site that had structural defects.

It is unlikely that the removal of these three trees would significantly impact on the availability of tree hollows for local viable populations of microbat species. However, as a precaution, it is recommended that at least six nest boxes that are suitably designed for bat roosts be placed in appropriate locations within the subject site as part of the proposed development. An appropriately designed nest box (Franks & Franks, 2003) is shown in Appendix C.

The subject site is only 5.74 ha in area, which is a negligible proportion of total foraging habitat that is available for microbats within the locality and broader geographical region.

Therefore, the proposed development is unlikely to have an adverse effect on the life cycle of East Coast Freetail-bats, Hoary Wattled Bats, Large-footed Mouse-eared Bats or Greater Broad-nosed Bats such that a local population of each of these species is likely to be placed at risk of extinction.

Microbats Dependent on Caves & Mine-shafts
(Little Bentwing-bat and Eastern Bentwing-bat)

There is foraging habitat for the Eastern Bentwing-bat and potential foraging habitat for the Little Bentwing-bat on the subject site. The subject site is only 5.74 ha in area, which is a negligible proportion of total foraging habitat that is available for microbats within the locality and broader geographical region

There are no caves, mine-shafts, tunnels or bridges on the subject site. Therefore, it is unlikely to be any significant roosts of Little Bentwing-bats and Eastern Bentwing-bats on the site.

Therefore, the proposed development is unlikely to have an adverse effect on the life cycle of Little Bentwing-bats and Eastern Bentwing-bats such that a local population of each of these species is likely to be placed at risk of extinction.

(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.

Not applicable. Grey-headed Flying-foxes and microchiropteran bats are threatened species rather than endangered populations.

(c) In the case of an endangered ecological community or critically 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**
- **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. Threatened bat species are not endangered or critically endangered ecological communities.

(d) In relation to a habitat of a threatened species, population or ecological community:
- **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **(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**
- **(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.**

(i) Up to 5.74 ha of potential foraging habitat for bat species will be modified or removed as a result of the proposed development. This may include the removal of up to three hollow-bearing trees from the site.

(ii) The proposed development will not result in fragmentation or isolation of threatened bat habitat.

(iii) It is unlikely that the removal of these three trees would significantly impact on the availability of tree hollows for local viable populations of microbat species. However, as a precaution, it is recommended that at least six nest boxes that are suitably designed for bat roosts be placed in appropriate locations within the subject site as part of the proposed development. An appropriately designed nest box (Franks & Franks, 2003) is shown in Appendix C.

The subject site is only 5.74 ha in area, which is a negligible proportion of total foraging habitat that is available for microbats within the locality and broader geographical region.

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

No critical habitat for threatened bat species occurs in the locality.

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

Grey-headed Flying-fox

The priority actions for the protection of the Grey-headed Flying-fox in NSW are stated below:

1. Assess the impacts Grey-headed Flying-fox camps have on water quality, and publish results in a peer-reviewed journal (Low priority).

2. Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts (Low priority).

3. Complete national recovery plan in 2006 (Medium priority).

4. Conduct range-wide assessments of the population size of Grey-headed Flying-foxes at least once during the 5-year recovery plan to monitor population trends (Low priority).

5. Describe the species, age structure & demographics of flying-foxes killed in fruit crops to improve the understanding of the impact by assessing trends in the species, sex, age & reproductive status of animals killed on crops (Medium priority).

6. Determine characteristics of optimal roosting habitat for Grey-headed Flying-foxes, exploring the roles of floristic composition, vegetation structure, microclimate and landscape features, and assess the status of camps (Medium priority).

7. Develop & provide to land managers & local community groups working with controversial flying-fox camps the resources needed for public education, highlighting species status, reasons for being in urban areas, reasons for decline etc (Medium priority).

8. Develop and implement a grower-based program to monitor trends in damage to

commercial fruit crops by flying-foxes, and use the results to monitor the performance of actions to reduce crop damage (Medium priority).

9. Develop and promote mechanisms for widespread adoption of publicly subsidised incentives to reduce killing of flying-foxes in commercial fruit crops (High priority).

10. Develop guidelines to assist land managers dealing with controversial flying-fox camps (Medium priority).

11. Develop methods for rapid estimates of flying-fox damage on commercial crops, allowing the long-term monitoring of industry-wide levels and patterns of flying-fox damage (Medium priority).

12. Develop methods to monitor landscape scale nectar availability trends, to explain/potentially predict crop damage trends where crop protection is absent, & promote importance of foraging habitat productive in seasons critical to the horticulture industry (Low priority).

13. Document the levels of flying-fox damage to the horticulture industry within the range of the Grey-headed Flying-fox (Medium priority).

14. Establish & maintain a range-wide database of Grey-headed Flying-fox camps, including information on location, tenure, zoning & history of use, for distribution to land management/planning authorities, researchers & interested public (Medium priority).

15. Establish and maintain a Grey-headed Flying-fox recovery plan website to promote the recovery plan and to circulate other information on flying-foxes and their conservation (Low priority).

16. Identify the commercial fruit industries that are impacted by Grey-headed Flying-foxes, to provide an information base for use by the various stakeholders (Medium priority).

17. Implement appropriate vegetation management actions at camps critical to the survival of Grey-headed Flying-foxes (Medium priority).

18. Improve knowledge of Grey-headed Flying-fox camp locations, targeting regional areas and seasons where information is notably incomplete, such as inland areas during spring and summer (Medium priority).

19. Increase the extent and viability of foraging habitat for Grey-headed Flying-foxes that is productive during winter and spring (generally times of food shortage), including habitat restoration/rehabilitation works (High priority).

20. Investigate between-year fidelity of Grey-headed Flying-fox individuals to seasonal camps (Low priority).

21. Investigate the age structure and longevity of Grey-headed Flying-foxes (Medium priority).

22. Investigate the differences in genetic relatedness, sex, age etc. between sedentary and transient Grey-headed Flying-foxes (Low priority).

23. Investigate the genetic structure within Grey-headed Flying-fox camps, including levels of relatedness within and between members of adult groups, occupants of individual trees etc (Low priority).

24. Investigate the patterns of juvenile Grey-headed Flying-fox dispersal and mortality, allowing identification of the specific habitat requirements of juveniles (Low priority).

25. Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes (Medium priority).

26. Protect and enhance priority foraging habitat for Grey-headed Flying-foxes, for example through management plans, local environmental plans and development assessments, and through volunteer conservation programs for privately owned land (High priority).

27. Protect roosting habitat critical to the survival of Grey-headed Flying-foxes, for example through management plans, local environmental plans and development assessments, and through volunteer conservation programs for privately owned land (Medium priority).

28. Publish Grey-headed Flying-fox recovery plan newsletters to inform the public of the recovery plan, its progress, opportunities for participation in actions and lists of educational material and where to find them (Low priority).

29. Review & evaluate campsite management activities, summarising outcomes of past experiences at controversial camps. Noise impacts on neighbours of camps to be considered. For use in managing future conflicts with humans at flying-fox camps (Medium priority).

30. Review and improve methods used to assess population size of Grey-headed Flying-foxes (Low priority).

31. Set priorities for protecting foraging habitat critical to the survival of Grey-headed Flying-foxes and generate maps of priority foraging habitat (High priority).

The proposed development is consistent with the priority actions for the recovery of the Grey-headed Flying-fox in NSW.

Microchiropteran Bats

There are currently no NSW recovery or threat abatement plans for microchiropteran bat species.

(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.

The proposed development is not part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process on threatened bat species provided that the recommendation presented in Point (a) is implemented.

3. CONCLUSION

The proposed development is unlikely to significantly impacted on the status of the Grey-headed Flying-fox, East Coast Freetail-bat, Hoary Wattled Bat, Large-footed Mouse-eared Bat, Greater Broad-nosed Bat, Little Bentwing-bat or Eastern Bentwing-bat, or their habitats. Therefore, a Species Impact Statement is NOT required for any of the threatened bats as part of the proposed development.

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Appendix C

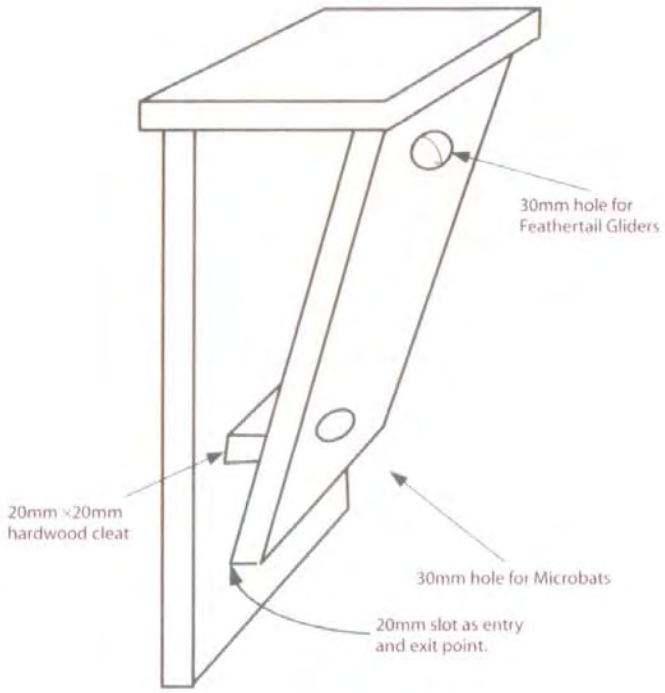
Recommended Nest Box Designs for Microbats

(Franks & Franks 2003)

Feathertail Glider/Microbat

BOX

Note: Side removed to show detail



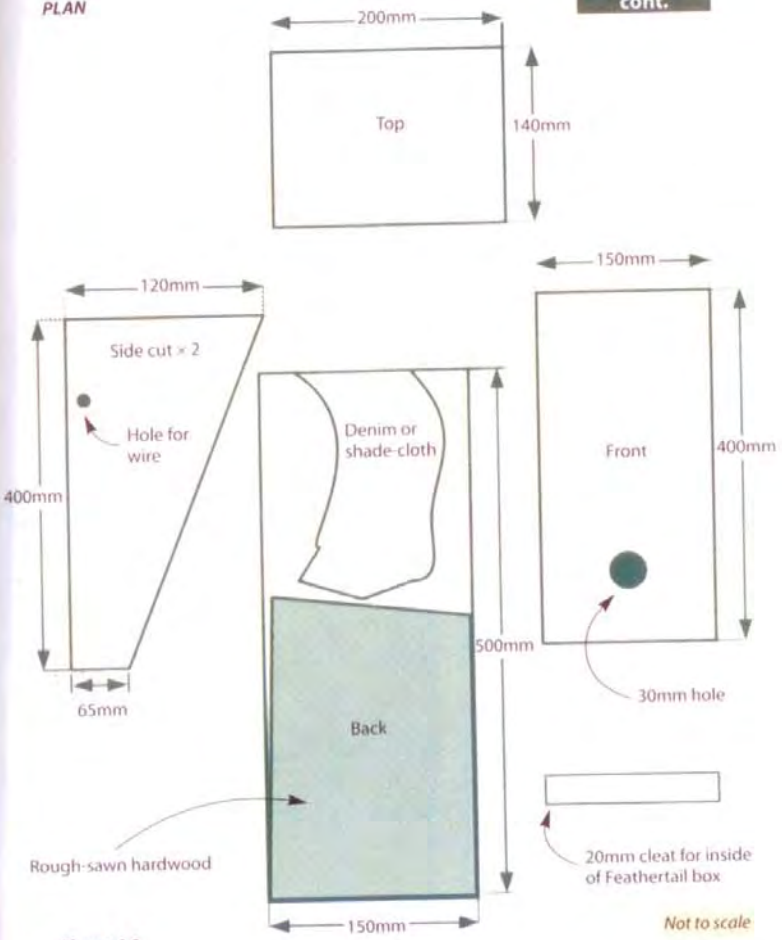
Not to scale

Figure 4.7

Feathertail Glider/Microbat

BOX cont.

PLAN

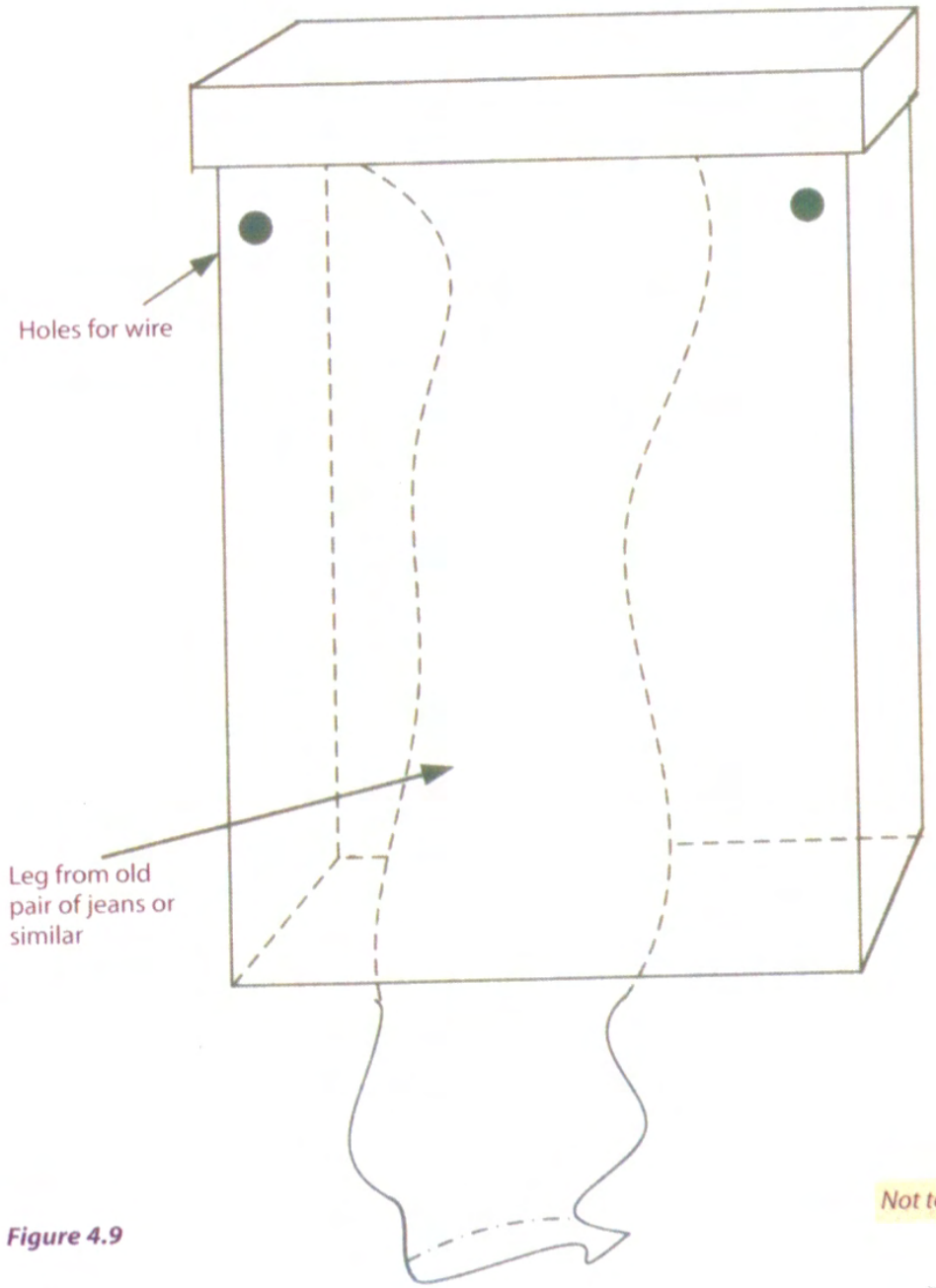


Not to scale

Figure 4.8

A Simple hanging Microbat BOX

This box hangs under a horizontal limb.
The dimensions may be varied to almost any size.



Not to scale

Figure 4.9