VERTEBRATE FAUNA ASSESSMENT

WAROONA MINERAL SANDS PROJECT AREA

Prepared for Iluka Resources Ltd

By Ninox Wildlife Consulting

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Summary

Following a previous survey in October 2003, Ninox Wildlife Consulting was commissioned by Iluka to provide an inventory of vertebrate fauna species present or potentially occurring in the Waroona Mineral Sands Project Area. This recent assessment concentrated on three locations in particular and the regional and local conservation value of rare, threatened and vulnerable species known or predicted to occur. In addition, the fauna habitats in the transition zone between the Swan Coastal Plain and the Darling Scarp were to be assessed and the significance of any ecological linkage in the Project Area and the broader district were to be described.

The 50 species of bird that have been recorded within the Project Area to date are generally typical of farmland with fragmented remnants of degraded native vegetation. It is possible that an additional 34 species could be recorded over time depending upon seasonal conditions. Many of these species are either habitat specialists with a reduced distribution on the Swan Coastal Plain (SCP) or are wide-ranging species with reduced populations which have become extremely scarce on the SCP and Darling Range foothills, although they may be common elsewhere. A flock of approximately 100 Baudin's Cockatoos were observed within the Project Area during September 2005. These birds are listed as Vulnerable under both State and Commonwealth legislation. One additional bird listed under these Acts, Carnaby's Cockatoo, may also be present. The Peregrine Falcon, listed under State legislation, and five birds listed on international treaties could also occur. One Department of Conservation and Land Management (CALM) Priority species, the Forest Red-tailed Black-cockatoo, was recorded during this assessment.

Four species of native mammal have been recorded within the Project Area either by observation or by signs such as scats, tracks and diggings. Although a further 17 species are thought to occur in the general area, their presence within the Project Area is unlikely given the fragmented and degraded condition of much of the remnant vegetation in the site. Surveys that have been conducted in bushland areas in Byford, Mundijong, Serpentine and Keysbrook to the north of Waroona have resulted in very few ground-dwelling native mammals being captured. The Southern Brown Bandicoot which was recorded by diggings in the Project Area is listed under CALM's Priority Fauna list.

Six species of frog have been recorded by male breeding calls in the Project Area, mainly in the dams and soaks within cleared areas. All of these frog species are common and widespread in the region and none are considered rare, threatened or vulnerable. Five species of reptile were identified during the October 2003 survey but none were recorded during this current assessment. The cold and wet weather conditions probably contributed significantly to the lack of reptile observations and/or captures by hand-foraging during this current assessment. Up to 49 additional species could occur in the general area although, as for native mammals, this is unlikely given the fragmented and degraded condition of the remnant vegetation. Between eight and 23 species of reptile have been recorded in the various bushland sites mentioned above. The Carpet Python, discussed as potentially occurring in the Project Area, is listed as Other Specially Protected Fauna under State legalisation.

Three introduced mammals including two predators and one herbivore and two introduced birds have been recorded in the Project Area. An additional two introduced rodents and at least two exotic birds could be expected to occur.

In a region that has been substantially cleared, any remnant of native vegetation is of value to vertebrate fauna although the fragmented and degraded nature of the remnants within the Project Area limits their value. They are not connected to each other by vegetated corridors or to any other area of native vegetation in the Darling Scarp or SCP. However, present within some of the remnant patches are large mature Eucalypt trees that contain hollows of various sizes that are likely to provide roosting/nesting sites and shelter for a large range of species ranging from black-cockatoos to arboreal reptiles and bats. A large amount of fresh possum scats were noted on stumps and logs in the vicinity of these trees in two of the remnant areas. The mitigation measures proposed within the PER for the Waroona Mineral Sands Project will alleviate some of the issues arising from clearing of some of these remnants. Some additional recommendations for improving the situation for vertebrate fauna species and their habitats are given in this current report.

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1 INTRODUCTION

The Waroona Mineral Sands Project Area is situated approximately 110 km south of Perth and just north of Waroona, Western Australia. The Project Area has been described in detail in GHD (2004). These details have not been reproduced in this current document unless specific elements warrant it.

On August 15, 2005, the Environmental Protection Authority Service Unit (EPASU) provided comments on a draft Public Environmental Review (PER) submitted by Iluka Resources Ltd (Iluka). These comments required addressing prior to the PER being finalised for public review. Ninox Wildlife Consulting (Ninox) has been commissioned by Iluka to provide information relating to the comments provided by the EPASU.

Specifically, the requirements are:

- to provide an inventory of vertebrate fauna species present or potentially occurring in the Project Area based on actual survey and literature review;
- an assessment of the regional and local conservation value of rare, threatened and vulnerable species that could occur in the Project Area as listed under:
    1. the *Environment Protection and Biodiversity Act 1999* (*EPBC 1999*);
    2. the *Wildlife Conservation Act 1950* (*WCA 1950*);
    3. Department of Conservation and Land Management (CALM) Priority Fauna list;
    4. those birds that have special conservation significance on the Swan Coastal Plain as listed in Table 15 of Bush Forever Volume 2 (Government of Western Australia 2000);
- for the fauna survey to be in accordance with the EPA's Guidance Statement No. 56 at a Level 2 Detailed Survey;
- to describe the extent and nature of native vegetation and habitat in the transition zone between the Swan Coastal Plain and the Darling Scarp;
- to provide an assessment of the significance of any ecological linkage in the Project Area and the broader district.

A Level 2 Detailed Survey as defined in Guidance Statement No 56 (EPA 2004) incorporates background research, a reconnaissance survey and the results of one or more site visits to enhance the level of knowledge at the locality scale.

Additional field work in the remnant vegetation of the Waroona Mineral Sands Project Area was conducted in early September 2005 to increase the level of knowledge on the existing vertebrate fauna population. This field assessment by Ninox concentrated on two particular remnant vegetation patches within the Project Area: Site 9 and Site 16, although other remnants and a range of wetland habitats were also visited. This document therefore integrates the results from the previous GHD survey, this second field assessment and a detailed literature review.

2 DEFINITION OF TERMS

Prior to any discussion of the significance of vertebrate fauna or their habitats a definition of terms is required. This Section of the document describes the various Commonwealth and State Acts that cover rare, threatened and vulnerable vertebrate fauna species and was correct at the time of the preparation of this document. However, as changes are made to both State and Commonwealth legislation and new treaties are entered into, all current documentation regarding rare, threatened and vulnerable fauna should be periodically reviewed for any changes to the status of these animals in a given area.

Additionally, in any discussion of rare, threatened or vulnerable species, several aspects require clarification before the significance of these species can be considered in context of the development and operation of a mining project.

- Resident, habitat-specific rare fauna are much more susceptible to the influences of disturbance than nomadic or migratory species.
- Not all rare species are equally susceptible to disturbance. Some rare species such as the Peregrine Falcon can accommodate the high levels of disturbance present in urban and rural environments.
- The concept of species rarity is a dynamic process considerably influenced by the level of survey work carried out in a particular location.

2.1 Protected Species - Commonwealth

In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered, vulnerable or presumed extinct species was constructed (Schedule 1) and is regularly updated (*Endangered Species Protection Act 1992*).

In July 2000 this Act was replaced by *The Environment Protection and Biodiversity Conservation Act 1999 (EPBC 1999),* which retained the schedule of threatened species of the Act it replaced.

The vertebrate fauna listed on the current schedule differs from the two State lists, although there are several species that appear on both, for example, the Chuditch, and Baudin's and Carnaby's Black-Cockatoos. There are six parts to the EPBC Act covering species that are:

- extinct;
- extinct in the wild;
- critically endangered;
- endangered;
- vulnerable;
- conservation dependent.

2.2 Protected Species - Western Australia

Currently in Western Australia, rare or endangered species are protected by the *Wildlife Conservation Act 1950 (WCA 1950)*. The various schedules defined under this act are:

- Declared Threatened Fauna - fauna that is ranked as presumed extinct, critically endangered, endangered or vulnerable;
- Conservation Dependent Fauna; and
- Other Specially Protected Fauna.

This Act is periodically reviewed and the current list of protected fauna can be viewed on CALM's Faunabase website. Burbidge (2004) acknowledges however, that the *Wildlife Conservation Act 1950* is now outdated and a Biodiversity Conservation Bill is currently being prepared for introduction to Western Australia's Parliament.

2.3 Priority Species - Western Australia

The Department of Conservation and Land Management (CALM) Priority Fauna List classifies species as:

- Priority 1 - taxa with few, poorly known populations on threatened lands;
- Priority 2 - taxa with few, poorly known populations on conservation lands;
- Priority 3 - taxa with several, poorly known populations, some on conservation lands;
- Priority 4 - taxa in need of monitoring.

The Priority Fauna List does not confer any additional legal protection to the species listed apart from the normal protection afforded to most native animals. It does, however, indicate the need for vigilance during the construction and commissioning of development projects to manage native vegetation and rehabilitation so that Priority species, should they occur, do not meet the criteria for listing on the Threatened Species List as a result of that development.

2.4 International Agreements

A range of birds are listed under the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements. Most of the species listed on the JAMBA and/or CAMBA agreements are shorebirds associated with coastal shores or inland saline wetlands and most are not relevant to the current Waroona Mineral Sands Project Area. However, there is a small range of birds listed on these international treaties that could occur within the Project Area and these species are discussed in this report.

2.5 Significant Fauna Habitats

Australia-wide, a small number of Threatened Ecological Communities (TEC) has been defined under Commonwealth legislation. However, while not defined under any legislation, some fauna habitats within a proposed mining area may be defined as locally significant because they:

- support rare or vulnerable species;
- support specialised or habitat specific fauna;
- are regionally or locally uncommon; or
- are restricted in area.

Although not protected under any State or Commonwealth legislation, in the interests of good project management, where possible, conservation of such locations within a project area will provide the basis for the fauna component of an environmental management plan to be put in place for the duration of a project.

3 METHODS

A detailed literature review consisted of three parts:

1. a search of State and Commonwealth vertebrate fauna databases;
2. a review of published literature on the vertebrate fauna of the general area;
3. a review of unpublished records from the general area held by Ninox Wildlife Consulting.

A table showing the results of a search of the Western Australian Museum's database was presented in GHD (2004). This has been adapted for use in this current document. In addition, the field records as shown in the earlier report have also been used (Appendix 1). The nomenclature in this report follows the Western Australian Museum checklist except where errors in this list have occurred.

The follow-up field survey was conducted by Ninox Principal Jan Henry assisted by Maureen Francesconi between the afternoon of 7 September and the morning of 9 September 2005. This survey was done in order to gain as much information as possible on the birds of two areas in particular: Sites 9 and 16 as shown in GHD (2004). However, locations such as Site 8 (adjacent to and east of Site 9), Ferraro Brook, Mullins Sumpland and various dams and soaks within the Project Area were also visited. The actual results from this recent assessment have been integrated into Appendix 1.

Weather conditions were wet, blustery and cold during the three day sampling period, although there were occasional intervals of sunshine. Sites 9 and 16 were visited on four occasions over the three days: Wednesday afternoon, Thursday morning and afternoon and Friday morning. Regardless of weather conditions, both personnel slowly walked through both Sites 9 and 16 recording all birds both seen and heard. Logs were turned over and bark removed from dead trees in order to locate any frogs or reptiles that might be present, and

signs of animal presence such as scats, tracks and diggings were identified and noted. Large trees, mainly Marri (*Corymbia calophylla*) were inspected for nesting hollows suitable for either the rare Baudin's Cockatoo or CALM Priority listed Red-tailed Black-cockatoos.

4 SITE DESCRIPTION

The Waroona Mineral Sands Project Area has been described in detail in GHD (2004). However, for ease of reference, a brief summary of the three major vegetation complexes has been provided below.

1. Swan Coastal Plain - Guildford Complex: most of the flat land on the site has been grazed by cattle, and as such, species diversity of the remnant vegetation has been reduced and is limited to large trees and unpalatable shrubs.

2. Ridge Hill Shelf - Forrestfield Complex: in most parts of the Project Area the understorey has been significantly grazed by cattle but there are some groundcover (often tuberous) species remaining at most sites.

3. Darling Scarp Complex - lateritic hilltops and hillsides, and granitic slopes all exhibited vegetation in a poor condition. While some shrubs and herbaceous species were present, grazing, pasture species and weeds have reduced their diversity.

Following the GHD 2003 assessment Mattiske Consulting Pty Ltd was commissioned by Iluka to review the flora and vegetation of three areas of remnant vegetation within the Project Area and to report on the plant communities present, assess their regional conservation values and to recommend ways of mitigating the impacts of mining-related activities (Mattiske Consulting Pty Ltd 2005). These three areas of remnant vegetation were Sites 9 and 16 as discussed earlier and a wetland within pasture: Mullins Sumpland. When discussing Sites 9, 16 and Mullins Sumpland, this more recent flora and vegetation document has been referred to in this fauna assessment

5 RESULTS

A field survey of the whole Project Area was carried out over two days in October 2003 by GHD to examine the habitats present and their condition, and to carry out an opportunistic survey of the vertebrate fauna (GHD 2004). The visit followed a winter of average rains. Weather conditions during this 2003 survey were overcast and windy. Ground conditions were still moist under logs, rocks and debris. The results of this GHD survey have been incorporated into Appendix 1 which lists the vertebrate fauna species recorded and species predicted to occur in the habitats of the Project Area. This latter group was compiled from the results of the Ninox review of published and unpublished data.

Appendix 1 shows that the results of the GHD field survey included 41 bird species, four native mammal species, two frog and eight species of reptile. Five feral or introduced species consisting of two birds and three mammals were also recorded. This current Ninox survey resulted in the recording of 38 species of bird, three species of native mammals, six frog but

no reptile species within the smaller survey area as discussed in Section 3 (Appendix 1 and 2). Introduced species included one bird and three mammal species.

Literature sources for the construction of the predicted species list shown in Appendix 1 included but were not limited to:

- mammals, frogs and reptiles: Bush *et al*.(1995); Harvey *et al.* (1997);
- birds: Storr and Johnstone (1988); Storr (1991); Barrett *et al*. (2003); Johnstone and Storr (1998 and 2004)

5.1 Birds

Appendix 1 shows that 41 bird species were recorded during the GHD field survey and 38 species were recorded during the Ninox survey. However, 29 species were common to both and 21 species were unique to either the GHD or Ninox survey. This has resulted in a total number of 50 species being known to occur periodically within the Project Area.

Of the 38 species recorded during this current survey, eight species were recorded in Site 9 and 16 in Site 16 (Appendix 2). This Appendix shows that 25 species were observed in either cleared land or wetland habitats such as farm dams and sumps.

The results of the literature review showed that in addition to the species recorded within the Project Area, a further 34 species could be expected to occur as resident, nomadic, migratory or occasional visitors to the general area. Not all of these are likely to occur regularly within the Project Area as their preferred habitats are either not present or are extremely degraded. Additional species could occur as vagrants but these have not been listed in Appendix 1. This latter group of birds could occur following specific climatic events, either in the south-west or inland, which encourage birds into or away from their normal patterns of distribution.

Many of the species listed in Appendix 1 have become extremely scarce on the SCP and Darling Range foothills although they may be common elsewhere. These birds are either habitat specialists with a reduced distribution on the SCP or are wide-ranging species with reduced populations on the SCP; some may be locally extinct (Government of Western Australia 2000). The birds that fit into these categories include many birds of prey such as the Square-tailed and Whistling Kites, Brown Goshawk, Collared Sparrowhawk, Little Eagle and Wedgetail Eagle. Birds such as these are wide-ranging and being predators, will never have been particularly common. Other, small birds such as fairy-wrens and thornbills are less mobile than the larger birds and may only be surviving in remnants of native vegetation on the SCP (Government of Western Australia 2000) although they are still common in parts of the adjacent Darling Range (Dunlop *et al.* 1995 and Ninox Wildlife Consulting 2002, 2003). These species are discussed in more detail in Section 5.6.1.3.

The 50 species that have been recorded within the Project Area are generally typical of farmland with fragmented remnants of degraded native vegetation. While the number of species of bird will increase with additional field work, it is unlikely that this increase will be substantial.

5.2 Native Mammals

One native mammal, the Western Grey Kangaroo (*Macropus fuliginosus*) was recorded by GHD during the field survey in October 2003. The three additional species were noted by signs of their presence such as tracks, scats or diggings (Appendix 1). The Ninox survey confirmed the presence of Grey Kangaroos which were observed in both remnant vegetation and pasture, and diggings of Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) were also noted in Site 16. Fresh Common Brushtail Possum (*Trichosurus vulpecula*) scats were recorded in both Site 9 and 16 although they were much more common in the former site. However, more scats were seen in Site 8 than in any other location. This area is discussed in more detail in Section 5.7.

An additional 17 species could potentially occur in the Project Area, although this is unlikely given the fragmented and degraded condition of much of the remnant vegetation in the site. This number of species includes nine species of bat, a group that has not been systematically surveyed on the SCP and about which little information is available on current status (Government of Western Australia 2000).

Relatively little survey work on ground-dwelling fauna, including native mammals, has been carried out on the southern SCP. However, some unpublished data and a small number of published papers have been reviewed for this current assessment. Intensive, seasonal trapping by Ninox in an almost pristine remnant of 75 hectares of Banksia woodland near Keysbrook (West Kingia - part of Bush Forever site 77) resulted in only two native mammal species being captured: the Honey Possum (*Tarsipes rostratus*) and Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) (Ninox unpublished data). Grey Kangaroos were relatively common in the study area. Further north, in the much larger remnant bushland at Lowlands, near Serpentine (Bush Forever site 368 and 372), only two native mammal species were recorded during trapping: the Chuditch (*Dasyurus geoffroii*) and Common Brushtail Possum (*Trichosurus vulpecula*); and the Western Grey Kangaroo was observed (Ninox unpublished data).

In addition to the surveys discussed above, field surveys of three locations on the southern Ridge Hill Shelf and Pinjarra Plain (Brickwood Reserve, Cardup Nature Reserve and Norman Road bushland) between Byford and Mundijong, resulted in the capture of only two species of small native mammal: the Mardo (*Antechinus flavipes*) and Western Pygmy Possum (*Cercartetus concinnus*). Two additional species were observed, the Grey Kangaroo and Southern Brown Bandicoot (Harvey *et al.* 1997). Nine trapping sessions within a small reserve in Serpentine (Paul Robinson Reserve) have resulted in the capture of only a single native mammal species, the Southern Brown Bandicoot (B. Datson – Actis Environmental Services pers. comm.).

5.3 Amphibians

Two species of frog were recorded by GHD in October 2003 and six species were recorded by Ninox in this more recent survey. An additional five species could occur in the general area (Appendix 1) with many of these likely to occur in the Waroona Mineral Sands Project Area as several species are able to persist in degraded creeks and wetlands (personal observations).

Five species were recorded at both West Kingia and Lowlands although six species were recorded in total (Ninox unpublished data). Six species of frog were also recorded during the

Harvey *et al*. (1997) survey of Brickwood Reserve, Cardup Nature Reserve and Norman Road bushland and four have been recorded in the Paul Robinson Reserve in Serpentine (B. Datson – Actis Environmental Services pers. comm.). All of these species are listed in Appendix 1.

Most of the frogs known to occur in the general area rely on surface water to breed and all of the species recorded during this current survey were heard calling in the various wetland habitats of the Project Area. However, many will be found in various habitats some distance away from water outside of their breeding season.

5.4 Reptiles

Five species of reptile were identified during the GHD October 2003 survey. An additional two species were seen but their identification was not confirmed (Appendix 1). No reptiles were recorded during the current survey although hand-foraging was undertaken. The cold and wet weather conditions probably contributed significantly to the lack of reptile observations and/or captures by hand-foraging during this current assessment.

Up to 49 additional species could occur in the general area although, as for native mammals, this is unlikely given the fragmented and degraded condition of the remnant vegetation.

Only 16 species of reptile were recorded in the three areas sampled in the Harvey *et al*. (1997) study. Twenty-three species were recorded in West Kingia and eight species were recorded at Lowlands (Ninox unpublished data). However, some of the discrepancy between these two latter sites is most likely a result of the varying intensities of sampling rather than any inherent differences between the sites. After nine sampling sessions, 14 reptile species are known to occur within the Paul Robinson Reserve in Serpentine (B. Datson [Actis Environmental Services] pers. comm.).

While an almost complete assemblage of reptiles can be found on recently isolated, small areas of undisturbed native vegetation in the Darling Range (Ninox Wildlife Consulting 1996) it is unlikely that many are able to persist in highly disturbed and degraded remnant patches that have been isolated for a long period of time, such as those within the Project Area.

5.5 Introduced Species

Three introduced mammal species were recorded in October 2003 by GHD (Appendix 1). This included two predators, the Red Fox (*Vulpes vulpes*) and feral Cat (*Felis catus*), and one herbivore, the European Rabbit (*Oryctolagus cuniculus*). Two introduced bird species were also observed: the Laughing Turtle-dove and Laughing Kookaburra. Historically, birds such as the Sulphur-crested Cockatoo, probably aviary escapees, have been recorded in the general area (K. Youngson pers. comm.) although this species is not known to still occur in the Waroona area.

In addition to these species, a further two introduced rodent species could be expected to occur: the Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). Both of these rodents were recorded in all of the bushland sites sampled by Harvey *et al.* (1997). Two additional introduced bird species could also occur: the feral Pigeon or Rock Dove and the Spotted Turtle-dove.

While no introduced bird species were recorded in the bushland at either West Kingia or Lowlands, the Laughing Kookaburra and Laughing Turtle-dove were observed in the vicinity of the houses and outbuildings in both locations (personal observations). The House Mouse and Red Fox were also recorded in West Kingia and Lowlands (Ninox unpublished data).

It is unlikely that additional feral species to those described above will occur in the Waroona Mineral Sands Project Area. However, cattle have grazed most of the remnant patches of vegetation on the Project Area resulting in a highly modified environment. Unless fenced from cattle, these remnants will continue to degrade over time.

5.6 Significant Vertebrate Fauna Species

5.6.1 Birds

5.6.1.1 Commonwealth and State

One bird species listed as Vulnerable under both the *EPBC (1999)* and *WCA (1950)* was recorded by GHD during the October 2003 field survey: Baudin's Cockatoo (GHD 2004). A large flock of approximately 100 birds was observed within the Waroona Mineral Sands Project Area in all three days of assessment. These birds were observed feeding on Marri trees within the Project Area. It was noted that particular Marris were favoured by these birds and these were flagged with orange and blue plastic flagging tape. It is known that black-cockatoos have habitual and/or favoured feeding trees (R.E. Johnstone pers. comm.) therefore it was judged prudent to mark these individual trees in the event they can be conserved, or for future rehabilitation seed collection.

Carnaby's Cockatoo, which is listed as Endangered under the *EPBC (1999) Act* and Vulnerable under the *WCA (1950)* could also occur in the Waroona Mineral Sands Project Area. Both of these black-cockatoo species have undergone a dramatic decline in recent years due to the loss of either food resources or as a result of their low reproductive rate (Johnstone and Storr 1998).

The loss of black-cockatoo nesting hollows in mature eucalypts through invasion by feral Honey Bees and other birds such as Galahs and Australian Wood Duck has also had an impact on these large birds (R. Johnstone pers. comm.). Both the Galah and Australian Wood Duck have increased in number in the South-west in recent years. The Galah was a rare visitor to the SCP in 1940 but is now well established; there was an explosive increase in numbers of Australian Wood Duck in the 1940's to the mid-1950's due to the proliferation of farm dams and establishment of pastures (Johnstone and Storr 1998). Some trees with the potential to contain suitable black-cockatoo nesting hollows were noted during this assessment. Recommendations are given in Section 6 with regard to the possible loss of nesting hollows.

Three birds listed on the China/Australia Migratory Bird Agreement (CAMBA): Great Egret, Cattle Egret and Glossy Ibis; one bird listed on the Japan/Australia Migratory Bird Agreement (JAMBA): Rainbowbird; and one bird listed on both: Fork-tailed Swift; could occasionally be present in the Project Area (Appendix 1). The two Egrets and Glossy Ibis use a variety of wetland habitats including flooded pastures, farm dams and drains and are unlikely to be affected by the loss of a relatively small area of pasture on the southern SCP. The Fork-tailed Swift rarely lands in Australia but may be seen overhead, often ahead of storm fronts. The

Rainbowbird, however, is known to breed in the South-west, excavating a nesting burrow into flat sandy ground or sand banks, wherever the sand is able to support a burrow.

The Peregrine Falcon which is listed as Other Specially Protected Fauna on the Western Australian *WCA (1950)* could occur in the Project Area. This bird of prey may be seen hunting for ducks or pigeons over farmland and has taken advantage of disused quarries along the Darling Scarp and in the Eastern Goldfields where it uses the ledges for roosting and nesting (personal observations).

5.6.1.2 CALM Priority List

One bird, the Forest Red-tailed Black-cockatoo, that was recorded during this current assessment is listed as Priority 3 on CALM's Priority Fauna list. This cockatoo is more commonly seen in the Jarrah forest of the Darling Range although it will be observed in remnant Jarrah or Marri vegetation on the Darling Scarp and foothills. Johnstone and Storr (1998) state that the main impact on this species has been the destruction of forests with the subsequent loss of nesting and feeding resources. Forestry, mining and clearing for orchards, tree plantations, roads and powerlines have all resulted in the loss of habitat and nesting hollows for this species. Some recommendations are given in Section 6 with regard to the possible loss of nesting hollows.

5.6.1.3 Other Significant Bird Species

Forty-one of the 125 bird species listed in Appendix 1 are either habitat specialists with a reduced distribution (RD) on the SCP or are wide-ranging species with reduced populations (RP) on the SCP (Government of Western Australia 2000). This includes many of the birds of prey (RP), a number of small insectivores such as the Splendid Fairy-wren and various thornbills (RD) and a relatively large number of honeyeaters (RP). Most of these birds are common in the remainder of their geographic distribution but are reliant on the often fragmented and sometimes small remnant areas of native vegetation on the SCP.

Of the 41 species listed as RD or RP in Table 15 of Volume 2 of Government of Western Australia (2000) nine of the former and five of the latter have been observed in the Project Area during the two assessments (Appendix 1). These birds were mainly small insectivores while none of the honeyeaters listed as RP or RD were observed in either the 2003 or 2005 assessment.

5.6.2 Native Mammals

5.6.2.1 Commonwealth and Western Australia

The Chuditch (*Dasyurus geoffroii*) is listed as Vulnerable on both the *EPBC (1999)* and *WCA (1950)*. This marsupial has been frequently captured in the Darling Range (Ninox Wildlife Consulting 2002, 2003). Other captures include a single male captured at Lowlands (Ninox unpublished data), the first record of this species on the SCP for many years (WAM database). Other recent observations of this species include a large male on the western edge of the Darling Range at Keysbrook (personal observations).

5.6.2.2 CALM Priority List

One native mammal species that has been recorded in the Waroona Mineral Sands Project Area and an additional three species that could occur are shown on CALM's Priority Fauna list (Appendix 1). The Southern Brown Bandicoot was not seen but its presence was recognised by signs (scats, tracks or diggings) in October 2003 (GHD 2004) and during this current assessment.

The additional three species that could occur are the Common Wambenger (*Phascogale tapoatafa*), the Western Brush Wallaby (*Macropus irma*) and the Water Rat (*Hydromys chrysogaster*). However, a search of the WAM database shows that there have been no recent specimens of any of these species. The most recent being a Common Wambenger recorded near Waroona in April 1960. A Water Rat has also been recorded in a degraded creekline on the western edge of the Darling Range at Keysbrook in 1994 (Ninox unpublished data). However, none of the surveys such as those at West Kingia, Lowlands and the Paul Robinson Reserve have resulted in the capture or observation of any of these three species.

5.6.2.3 Other Significant Native Mammal Species

The Government of Western Australia (2000) states that at least 33 native mammals once occurred on the SCP. Only 18 were recorded during 1978 and subsequent work on the SCP. It is also stated that there has been further decline in the last 20 years and the work discussed in Section 5.2 confirms the depauperate state of small native mammal species on the SCP, Ridge Hill Shelf and Darling Range foothills. Therefore, it can be said that all native mammals remaining in these areas are of significance.

5.6.3 Amphibians

None of the frogs recorded or predicted to occur in the general area or within the Waroona Mineral Sands Project Area are listed on any of the Government rare, threatened or vulnerable species lists.

5.6.4 Reptiles

Only one reptile that could potentially occur in the Project Area, the Carpet Python (*Morelia spilota imbricata*) is listed on any rare, threatened or vulnerable species list. This python is shown as Other Specially Protected Fauna on the *WCA (1950*). There are no recent records of this species in the general area of Waroona.

5.7 Fauna Habitats

The fauna habitats of the Waroona Mineral Sands Project Area were discussed in detail in GHD (2004). The range and condition of fauna habitats in the Project Area have been reassessed by Ninox following the second field assessment in September 2005.

Underlying any discussion on the value of the remnant vegetation of the Project Area is the extent of clearing for agriculture in the site and the degraded nature of many of the remnant

patches. GHD (2004) also state that larger remnant patches adjacent to the site on the Darling Plateau are likely to provide more significant fauna habitat than the remnants of the Project Area although it should be stated that any remnant is of some value in a fragmented landscape. GHD (2004) also discuss the condition of the understorey within all of the remnant patches within the Project Area. This current assessment took place mainly in Sites 9 and 16, therefore only some of the statements in GHD (2004) are relevant to this current document. Where required, the salient points from the GHD report have been reiterated in the following paragraphs.

Present within some of the remnant patches are large mature Eucalypt trees that contain hollows of various sizes that are likely to provide roosting/nesting sites and shelter for a large range of species ranging from black-cockatoos to arboreal reptiles and bats. In the north-east portion of Site 8 a large number of trees have been historically ringbarked and burnt and these trees have developed substantial hollows. Several of these dead trees were located adjacent to live trees (Plate 1) and this combination appears to provide excellent refuge and easy access for the Common Brushtail Possum.

Plate 1

Common Brushtail Possum (*Trichosurus vulpecula*) habitat trees in the north-east corner of Site 8.

A large amount of fresh possum scats were noted on stumps and logs in the vicinity of these trees although it was not possible to determine how many possums potentially occur within this location. A similar situation was apparent in Site 9 although scats were less abundant in this remnant. Possum scats were uncommon in Site 16.

While fresh Common Brushtail Possum scats were located and Grey Kangaroos were seen within Site 9, this site lacked an understorey of the woody shrubs that are typical of southwestern vegetation communities (Mattiske Consulting Pty Ltd 2005). Research has shown that the complexity of the structure of the vegetation bears a direct correlation to the diversity of bird species (Worsley Alumina Pty Ltd 1985, Ninox Wildlife Consulting 1997, 1998, 2002, 2003). As a result of this lack of a woody shrub stratum, only eight species of bird were recorded during this assessment (Appendix 2). This was very similar to the heavily grazed Site 8 nearby which also lacked a mid-storey of shrubs and has a mainly pasture grass ground cover. Although the ground cover of Site 9 is almost weed-free (Mattiske Consulting Pty Ltd 2005) the reason for the lack of shrubs is unknown. Therefore, for birds in particular, Sites 9 and 8 are very similar.

GHD (2004) state that Site 16 (speedway) has a healthy and mature tree cover with a healthy shrub and ground cover. The site has not been burnt for a substantial period of time and has a litter layer up to 15 cm thick in places. However, Mattiske Consulting Pty Ltd (2005) considers that only approximately 0.5 hectares of the 2 hectare site is currently in very good condition. The incursion of Love Grass (*Eragrostis curvula*) into the site is substantial (Plate 2) and because of the limited size and narrow shape of the site, there is only a very narrow central strip of native vegetation that is not affected by this exotic and persistent grass.

Plate 2
Site 16 (speedway) showing Love Grass (*Eragrostis curvula*) incursion.

This thick vegetation, including the exotic grasses, provides ideal cover for the Southern Brown Bandicoot *(Isoodon obeselus fusciventer)* and, during the GHD assessment; signs of their presence were numerous across the site. GHD note that this is a CALM Priority 4 species and while not endangered, it remains threatened from predation by the Red Fox, feral Cats and domestic Dogs. During the Ninox assessment, signs of the bandicoot in this site were few although fresh tracks of both Red Fox and feral Cat were numerous. In the two years between the GHD and Ninox assessments, these two exotic predators may have had an impact on the bandicoots within the speedway area.

Of the six species of frog recorded during the Ninox assessment, only three species were heard calling in Mullins Sumpland: the Quacking Frog (*Crinia georgiana*), Squelching Frog (*Crinia insignifera)* and Lea's Frog (*Geocrinia leai)*. The boggy surrounds of this sumpland have been trampled by cattle and polluted by their dung reducing its value as a wetland habitat.

5.8 Ecological Linkages

The ecological linkages have been discussed in detail in GHD (2004). The following paragraphs have been extracted and reiterated in this document with minor changes.

The intermittent nature of remnant vegetation patches in the Project Area indicates poor vegetation linkage between habitats. Few of the remaining vegetation sites examined in this study retain significant shrub and groundcovers, minimising the likelihood of providing linkage between sites. Much of the eastern SCP has been cleared of vegetation over the last century for agricultural purposes, and few stands of remnant vegetation remain. In the Project Area, no linkages exist between the well forested western edge of the Darling Plateau and the flats of the SCP. It is therefore not likely to expect much faunal movement, apart from bird species and the occasional large mammal or reptile.

Generally, creeklines provide important linkages between upland and lowland habitats, but these too, have been impacted by land clearing practices, reducing their importance in providing corridors for faunal movement. Most of the ephemeral creeklines in the Project Area have been completely cleared in their lower reaches, and their usefulness as vegetation linkages is minimal. Wealand Brook retains the most vegetative cover, but its minimal linkage to other habitats both up and downstream reduces its viability as a corridor for faunal movement, particularly ground dwelling fauna.

Site 16 is relatively isolated and may be an important refuge for ground dwelling fauna. The lack of continuous linkage, particularly with the healthier forested areas of the Darling Plateau indicates that the relative isolation means this site is more vulnerable to impact from weed invasion and feral herbivores such as the European Rabbit.

6 CONCLUSIONS

In general, regardless of its condition, any remnant vegetation that remains between the Darling Scarp and the west coast is of some value to vertebrate fauna as a result of the extent of clearing for agriculture and urbanisation. However, given the weed invasion and continuing grazing by cattle through most of them, the remnant vegetation patches have a limited value to vertebrate fauna. The mitigation measures proposed within the PER for the Waroona Mineral Sands Project will alleviate some of the issues arising from clearing of Site 16 in particular and Eucalypt woodlands in general. Some additional recommendations for improving the situation for vertebrate fauna species and their habitats are given in Section 7 of this report.

7 RECOMMENDATIONS

7.1 Site 9

As stated in Mattiske Consulting Pty Ltd (2005) the lack of weed species in Site 9 may be the result of selective grazing. The presence of Grey Kangaroos in this site and the relative lack of cattle dung may indicate that selective grazing by native herbivores may be the reason for the weed-free status of this site. European Rabbits did not appear to be present at the time of the Ninox assessment, probably a result of the lack of cover where there was no shrub understorey. As this site is not within the proposed clearing zone for the mine, this location should be fenced to exclude cattle but allow Grey Kangaroos to graze. The result of this type of fencing should be monitored to understand the dynamics of this location and action be taken to prevent further deterioration of the vegetation and its habitat values.

7.2 Site 16

As Site 16 lies within the clearing boundary for the proposed mine nothing can be done to preserve the habitat value of this location. However, as stated in Mattiske Consulting Pty Ltd (2005), the establishment of similar vegetation in a suitable position elsewhere in the Project Area should be investigated.

GHD (2004) state that the Southern Brown Bandicoot is relatively common throughout the South-west and the potential loss of the individuals at Site 16 will not endanger the species generally. Because of the isolation of this remnant, there will be little opportunity for these animals to move to other areas of shelter once clearing begins. Relocation of these individuals to remnant patches within the Project Area that will not be cleared for mining or infrastructure purposes is recommended as these locations may be within the animals' territory and may not, therefore, result in conflict with existing populations.

7.3 Mullins Sumpland

The three frog species recorded in Mullins Sumpland are common and widespread throughout the South-west. As a result of substantial rainfall in recent weeks and the resulting inundation of paddocks and low-lying areas on the southern SCP, there was little in the way of bird life on this sump at the time of the Ninox assessment. As this is a seasonally-inundated basin, there are no distinct faunal values that are attached to this location. Therefore, there are no

specific recommendations for this site over and above those discussed in Mattiske Consulting Pty Ltd (2005).

7.4 Other Locations

GHD (2004) state that the value of remnant vegetation and associated fauna habitats can be maximised by leaving a proportion of larger trees with hollows where possible and avoiding clearing in the breeding season of the Baudin's Cockatoo between October and November.

Further to this, it was noted during the Ninox assessment that a number of birds including the Australian Ringneck, Elegant Parrot, Australian Kestrel and Tree Martin were using or investigating tree hollows in dead trees in paddocks within the Project Area. Where possible within the Project Area, these trees should be retained alleviating additional pressure on hollows within remnant vegetation.

The north-east corner of Site 8 contains a number of dead trees with hollows that appear to provide shelter for the Common Brushtail Possum. If possible, this corner should be left intact. However, this portion of Site 8 currently lies within the area shown in the clearing plan. Therefore, if this corner cannot be retained it is recommended that a possum trapping program is considered and the captured animals relocated to nearby remnant vegetation within the Project Area. As for bandicoots, these locations may already be within the animals' territory and may not result in conflict with existing populations. Within Site 8, the large, dead trees that contain a number of hollows should be relocated and placed on the ground in the portion of site 8 that is not included in the clearing plan. These trees are likely to become an important refuge for ground-dwelling fauna.

The loss of food resources has been given as one of the reasons for the decline of the large black-cockatoos therefore, where possible, the large Marri trees that have been marked as favoured feeding trees for Baudin's Cockatoo should be retained. Some of these trees are located within the road verge of Peel Road East and are not included in the clearing plan for the proposed mine. However, one or two of these trees are on the western boundary of the clearing plan and if they have to be removed it is recommended that seeds are collected from these trees prior to clearing. These seeds should be used in future rehabilitation in the hope that they retain the genetic material that attracts Baudin's Cockatoo to feed on the parent tree. One particular tree situated in a paddock approximately 300 metres north-west of Site 16 appeared to support a very large number of feeding Baudin's Cockatoos. This tree is located on the extreme north-western edge of the proposed Main Pit. A minor adjustment of the boundary of this pit could result in the retention of this apparently important tree. As for the trees located along Peel Road East, if this is not possible, seeds are collected from this tree for future rehabilitation areas.

In addition to the loss of food resources, the loss of black-cockatoo nesting hollows is of great concern (R.E. Johnstone pers. comm.). The clearing plan for the Waroona Mineral Sands Project includes the loss of a number of mature Jarrah and Marri trees which may contain suitable hollows. The presence of a large flock of Baudin's Cockatoos in the area during both the 2003 and 2005 assessments indicates that they may breed in the general area. Therefore, it is recommended that Iluka enters into discussion with R.E. Johnstone (Western Australian Museum) to confirm whether or not these birds will lose nesting hollows from areas that are to be cleared.

The Western Australian Museum, in association with the Water Corporation, is currently conducting trials of artificial nesting boxes for breeding by Red-tailed Black-cockatoos and the two species of White-tailed Black-cockatoos known to occur in the South-west. A partnership between Iluka and the Western Australian Museum to expand the range of these trials should be considered as part of the conservation of the two species of black cockatoos that are known to occur in the Waroona Mineral Sands Project Area.

Should the Waroona Mineral Sands Mine be given approval, Iluka has committed to a vegetation and biodiversity plan for Ferraro Brook that runs through the Project Area. This plan includes fencing from stock and infill planting with native riparian plants which will stabilise the banks of the brook and prevent further degradation. However, there are a range of additional procedures that can assist with this process and increase the habitat value of the brook. Much of the following information has been summarised from Pen (1999) which provides an extensive body of information on the restoration and management of creeks and rivers.

In highly modified creeks and rivers, a major problem is the high speed at which the water flows. This high speed increases the undercutting of banks, prevents pools from forming where aquatic invertebrates can live and breed, impedes the establishment of aquatic plants and also scours the river or creek bed. Therefore, the first action to increase the biological diversity of rivers and creeks is to slow the water velocity. Consequently, in order to increase the habitat value for both vertebrate and invertebrate fauna the following additional measures are recommended.

- Large woody debris such as logs is placed along and across the stream bed and on the stream banks. These will start to slow the water velocity, catch smaller debris and soil, create small pools and stabilise banks.
- Riffles are created with areas of rocks which will arrest serious erosion and assist in aerating the water.
- Stock crossings and watering points are lined with rocks which will deter the cattle from remaining at the crossing for any period of time. This will alleviate some of the pollution from dung and degradation of the banks at these points.
- The very large exotic fig tree that is currently growing midway along Ferraro Brook is removed. This is a particularly invasive plant within stream zones and will eventually colonise along the creek.

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APPENDIX 1 List of vertebrate fauna species recorded or predicted to occur in the various habitats of the Waroona Mineral Sands Project Area.

Key

Data sources
- WAM = Western Australian Museum database
- 10/03 = GHD field survey
- 9/05 = Ninox field survey (to be completed)
- OT = Ninox unpublished & personal data
  (Those left blank indicate species distribution maps only)

Conservation Status - Western Australia
- CR = Critically Endangered under the Wildlife Conservation Act 1950
- VU = Vulnerable under the Wildlife Conservation Act 1950
- OP = Other Specially Protected Fauna under the Wildlife Conservation Act 1950
- P# = Listed under CALM's Priority Fauna list

Conservation Status - Commonwealth
- V = Vulnerable under the EPBC Act 1999
- E = Endangered under the EPBC Act 1999
- J = JAMBA treaty
- C = CAMBA treaty

Significant Bird Species (Table 15 Bush Forever Vol. 2)
- RD = Habitat specialists with a reduced distribution on the Swan Coastal Plain
- RP = Wide-ranging species with reduced populations on the Swan Coastal Plain locally extinct

		Status	Lit. Rev.	WAM	10/03	9/05	OT
BIRDS							
CASUARIIDAE							
Dromaius noveahollandiae	Emu	RP	X		X		
PHASIANIDAE							
Coturnix pectoralis	Stubble Quail		X				
ANATIDAE							
Cygnus atratus	Black Swan		X				
Tadorna tadornoides	Australian Shelduck		X		X	X	X
Chenonetta jubata	Australian Wood Duck		X		X	X	X
Anas gracilis	Grey Teal		X		X	X	X
Anas superciliosa	Pacific Black Duck		X		X	X	X
PODICIPEDIDAE							
Tachybaptus novaehollandiae	Australasian Grebe		X	X	X		
PHALACROCORACIDAE							
Phalacrocorax sulcirostris	Little Black Cormorant		X				X
Phalacrocorax melanoleucos	Little Pied Cormorant		X			X	
ARDEIDAE							
Ardea pacifica	White-necked Heron		X				X
Ardea novaehollandiae	White-faced Heron		X		X	X	X
Ardea alba	Great Egret	C	X				
Ardea garzetta	Little Egret		X				
Ardea ibis	Cattle Egret	C	X				
Nycticorax caledonicus	Rufous Night Heron	RP	X				
THRESKIORNITHIDAE							
Plegadis falcinellus	Glossy Ibis	C	X				
Threskiornis molucca	Australian White Ibis		X		X	X	X

		Status	Lit. Rev.	WAM	10/03	9/05	OT
Threskiornis spinicollis	Straw-necked Ibis		X		X	X	X
Platalea regia	Royal Spoonbill		X				
Platalea flavipes	Yellow-billed Spoonbill		X				
ACCIPITRIDAE							
Elanus caeruleus	Black-shouldered Kite		X		X		X
Hamirostra isura	Square-tailed Kite	RP	X	X			
Haliastur sphenurus	Whistling Kite	RP	X				X
Accipiter fasciatus	Brown Goshawk	RP	X	X		X	X
Accipiter cirrhocephalus	Collared Sparrowhawk	RP	X	X			
Aquila morphnoides	Little Eagle	RP	X				
Aquila audax	Wedge-tailed Eagle	RP	X			X	X
Circus assimilis	Spotted Harrier		X				
Circus approximans	Swamp Harrier		X				
FALCONIDAE							
Falco berigora	Brown Falcon	RP	X				X
Falco cenchroides	Australian Kestrel		X		X	X	X
Falco longipennis	Australian Hobby		X		X		
Falco peregrinus	Peregrine Falcon	OP/RP	X				X
TURNICIDAE							
Turnix varia	Painted Button-quail	RP	X				X
RALLIDAE							
Porphyrio porphyrio	Purple Swamphen		X				
Gallinula ventralis	Black-tailed Native-hen		X				
Gallinula tenebrosa	Dusky Moorhen	RD	X				
Fulica atra	Eurasian Coot		X				
CHARADRIIDAE							
Vanellus tricolor	Banded Lapwing		X				
Charadrius ruficapillus	Red-capped Plover		X				
Charadrius melanops	Black-fronted Dotterel		X				
Erythrogonyus cinctus	Red-kneed Dotterel		X				
COLUMBIDAE							
Phaps chalcoptera	Common Bronzewing	RD	X		X	X	X
Ocyphaps lophotes	Crested Pigeon		X				X
PSITTACIDAE							
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	P3	X	X	X	X	
Calyptorhynchus latirostris	Carnaby's Cockatoo	E/VU	X	X			X
Calyptorhynchus baudinii	Baudin's Cockatoo	V/VU	X	X	X	X	X
Cacatua roseicapilla	Galah		X		X	X	X
Glossopsitta porphyrocephala	Purple-crowned Lorikeet		X				
Polytelis anthopeplus	Regent Parrot		X	X			X
Platycercus zonarius	Australian Ringneck		X	X	X	X	X
Platycercus spurius	Red-capped Parrot		X	X	X	X	X
Platycercus icterotis	Western Rosella	RP	X	X			
Neophema elegans	Elegant Parrot		X	X		X	X
CUCULIDAE							
Cuculus pallidus	Pallid Cuckoo		X	X			X
Cacomantis flabelliformis	Fan-tailed Cuckoo		X				X
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo		X				X
Chrysococcyx lucidus	Shining Bronze-Cuckoo		X	X			X
STRIGIDAE							

		Status	Lit. Rev.	WAM	10/03	9/05	OT
Ninox novaeseelandiae	Southern Boobook		X				
TYTONIDAE							
Tyto novaehallandiae	Masked Owl	RP	X				
Tyto alba	Barn Owl		X	X	X		
PODARGIDAE							
Podargus strigoides	Tawny Frogmouth		X	X			
AEGOTHELIDAE							
Aegotheles cristatus	Australian Owlet-nightjar		X	X			
APODIDAE							
Apus pacificus	Fork-tailed Swift	J/C	X				
HALCYONIDAE							
Todiramphus sanctus	Sacred Kingfisher		X				X
MEROPIDAE							
Merops ornatus	Rainbow Bee-eater	J	X				X
CLIMACTERIDAE							
Climacteris rufa	Rufous Treecreeper	RD	X	X	X		
MALURIDAE							
Malurus splendens	Splendid Fairy-wren	RD	X	X	X	X	X
Stipiturus malachurus	Southern Emu-wren	RD	X	X			
PARDALOTIDAE							
Pardalotus punctatus	Spotted Pardalote		X				X
Pardalotus striatus	Striated Pardalote		X	X	X	X	X
ACANTHIZIDAE							
Sericornis frontalis	White-browed Scrubwren	RD	X	X	X		X
Smicrornis brevirostris	Weebill	RD	X				X
Gerygone fusca	Western Gerygone		X		X	X	X
Acanthiza apicalis	Broad-tailed Thornbill	RD	X	X			X
Acanthizia inornata	Western Thornbill	RD	X			X	X
Acanthizia chrysorrhoa	Yellow-rumped Thornbill	RD	X		X	X	X
MELIPHAGIDAE							
Lichmera indistincta	Brown Honeyeater		X		X	X	X
Lichenostomus virescens	Singing Honeyeater		X		X		X
Lichenostomus ornatus	Yellow-plumed Honeyeater	RD					
Melithreptus brevirostris	Brown-headed Honeyeater		X				
Melithreptus chloropsis	Western White-naped Honeyeater	RP	X				X
Phylidonyris novaehollandiae	New Holland Honeyeater	RP	X				X
Phylidonyris nigra	White-cheeked Honeyeater	RP	X				X
Phylidonyris melanops	Tawny-crowned Honeyeater	RP	X				
Acanthorhynchus superciliosus	Western Spinebill		X				X
Manorina flavigula	Yellow-throated Miner	RP	X				X
Anthochaera lunulata	Western Little Wattlebird	RP	X				X
Anthochaera carunculata	Red Wattlebird		X	X	X	X	X
Ephthianura albifrons	White-fronted Chat		X				X
PETROICIDAE							
Petroica multicolor	Scarlet Robin	RD	X		X	X	X
Petroica goodenovii	Red-capped Robin		X				X
Petroica cucullata	Hooded Robin	RD	X				X
Eopsaltria australis	Yellow Robin	RD	X				
Eopsaltria georgiana	White-breasted Robin	RD	X	X			
NEOSITTIDAE							

		Status	Lit. Rev.	WAM	10/03	9/05	OT
Daphoenositta chrysoptera	Varied Sittella	RD	X				X
PACHYCEPHALIDAE							
Pachycephala pectoralis	Golden Whistler	RD	X		X	X	X
Pachycephala rufiventris	Rufous Whistler		X			X	X
Colluricincla harmonica	Grey Shrike-thrush	RD	X		X		X
DICRURIDAE							
Myiagra inquieta	Restless Flycatcher	RD	X				
Rhipidura fuliginosa	Grey Fantail		X		X	X	X
Rhipidura leucophrys	Willie Wagtail		X	X	X	X	X
Grallina cyanoleuca	Magpie-lark		X		X		X
CAMPEPHAGIDAE							
Coracina novaehollandiae	Black-faced Cuckoo-shrike		X		X	X	X
Coracina maxima	Ground Cuckoo-shrike		X	X			
Lalage tricolor	White-winged Triller		X				
ARTAMIDAE							
Artamus personatus	Masked Woodswallow		X				
Artamus cinereus	Black-faced Woodswallow	RP	X				
Artamus cyanopterus	Dusky Woodswallow	RP	X		X	X	
CRACTICIDAE							
Cracticus torquatus	Grey Butcherbird		X	X	X	X	X
Cracticus tibicen	Australian Magpie		X	X	X	X	X
Strepera versicolor	Grey Currawong	RP	X	X	X		X
CORVIDAE							
Corvus bennetti	Little Crow		X				
Corvus coronoides	Australian Raven		X			X	X
HIRUNDINIDAE							
Hirundo neoxena	Welcome Swallow		X	X	X		X
Hirundo nigricans	Tree Martin		X			X	X
ZOSTEROPIDAE							
Zosterops lateralis	Grey-breasted White-eye		X		X	X	X
SYLVIIDAE							
Acrocephalus australis	Australian Reed-warbler		X				
Megalurus gramineus	Little Grassbird		X				
Cinclorhamphus mathewsi	Rufous Songlark		X				
Cinclorhamphus cruralis	Brown Songlark		X				
DICAEIDAE							
Dicaeum hirundinaceum	Mistletoebird		X				
PASSERIDAE							
Stagonopleura oculata	Red-eared Firetail		X	X			
MOTACILLIDAE							
Anthus australis	Australian Pipit		X	X		X	
NATIVE MAMMALS							
TACHYGLOSSIDAE							
Tachyglossus aculeatus	Echidna				X		
DASYURIDAE							
Antechinus flavipes	Mardo			X			
Dasyurus geoffroii	Chuditch	V		X			X
Phascogale tapoatafa	Wambenger	P4		X			
Sminthopsis gilberti	Gilbert's Dunnart			X			

		Status	Lit. Rev.	WAM	10/03	9/05	OT
Sminthopsis griseoventer	Grey-bellied Dunnart			X			
PERAMELIDAE							
Isoodon obesulus fusciventer	Southern Brown Bandicoot	P4			X	X	X
MACROPODIDAE							
Macropus fuliginosus	Western Grey Kangaroo				X	X	X
Macropus irma	Western Brush Wallaby	P4					
PHALANGERIDAE							
Trichosurus vulpecula vulpecula	Common Brushtail Possum			X	X	X	X
BURRAMYIDAE							
Cercartetus concinnus	Western Pygmy-possum			X			
VESPERTILIONIDAE							
Chalinolobus gouldii	Gould's Wattled Bat						
Chalinolobus morio	Chocolate Wattled Bat						
Falsistrellus mackenziei	Western False Pipistrelle						
Nyctophilus geoffroyi	Lesser Long-eared Bat			X			
Nyctophilus gouldii	Gould's Long-eared Bat			X			
Nyctophilus timoriensis	Greater Long-eared Bat						
Vespadelus regulus	Southern Forest Bat			X			
MOLOSSIDAE							
Mormopterus planiceps	Southern Freetail-bat						
Tadarida australis	White-striped Freetail-bat						
MURIDAE							
Hydromys chrysogaster	Water-rat	P4		X			
AMPHIBIANS							
HYLIDAE							
Litoria adelaidensis	Slender Tree Frog		X			X	
Litoria moorei	Motorbike Frog		X	X			
MYOBATRACHIDAE							
Heleioporus eyrei	Moaning Frog		X	X			X
Heleioporus psammophilus	Sand Frog		X				X
Limnodynastes dorsalis	Banjo Frog		X			X	X
Crinia georgiana	Quacking Frog		X	X	X	X	X
Crinia glauerti	Glauert's Froglet		X		X	X	X
Crinia insignifera	Squelching Frog		X	X		X	X
Geocrinia leai	Lea's Frog		X	X		X	
Myobatrachus gouldii	Turtle Frog		X				
Pseudophryne guentheri	Crawling Frog		X				X
REPTILES							
CHELUIDAE	**Freshwater Turtles**						
Chelodina oblonga			X	X			
AGAMIDAE							
Pogona minor				X			X
GEKKONIDAE							
Crenadactylus ocellatus			X	X			
Diplodactylus granariensis			X				
Diplodactylus polyophthalmus			X	X			
Underwoodisaurus milii			X	X	X		
Christinus marmoratus			X	X			

		Status	Lit. Rev.	WAM	10/03	9/05	OT
Gehyra variegata			X				
PYGOPODIDAE							
Aprasia repens			X				X
Delma fraseri			X	X			
Delma grayii			X				
Lialis burtonis			X	X			X
Pletholax gracilis							X
Pygopus lepidopodus			X	X			X
SCINCIDAE							
Acritoscincus trilineatum			X	X			X
Cryptoblepharus plagiocephalus			X		X?		X
Ctenotus fallens			X	X			X
Ctenotus impar			X				X
Ctenotus labillardieri			X	X	X?		
Egernia kingii			X	X	X		X
Egernia luctuosa			X				
Egernia napoleonis			X	X			
Egernia pulchra			X	X			
Glaphyromorphus gracilipes				X			
Hemiergis initialis			X	X			
Hemiergis quadrilineata			X	X			X
Lerista distinguenda			X	X			
Lerista elegans			X	X			X
Lerista lineopunctulata			X				
Lerista microtis				X			
Menetia greyii			X	X			X
Morethia lineoocellata			X	X			X
Morethia obscura			X	X			X
Tiliqua occipitalis			X				X
Tiliqua rugosa			X				X
VARANIDAE							
Varanus gouldii			X	X			X
Varanus rosenbergi			X	X	X		X
Varanus tristis			X				
TYPHLOPIDAE							
Ramphotyphlops australis			X	X			X
Ramphotyphlops pinguis			X	X			
BOIDAE							
Morelia spilota imbricata		OP	X	X			
ELAPIDAE							
Acanthophis antarcticus			X				
Elapognathus coronata			X	X			X
Neelaps bimaculatus			X				
Notechis scutatus			X	X	X		X
Parasuta gouldii			X	X			X
Parasuta nigriceps			X	X			
Pseudonaja affinis			X	X	X		X
Pseudonaja nuchalis			X	X			
Simoselaps bertholdi			X				
Simoselaps semifasciatus			X				

		Status	Lit. Rev.	WAM	10/03	9/05	OT
INTRODUCED SPECIES							
BIRDS							
COLUMBIDAE							
Columba livia	Feral Pigeon		X				
Streptopelia senegalensis	Laughing Turtle-Dove		X		X		X
Streptopelia chinensis	Spotted Turtle-Dove		X				
HALCYONIDAE							
Dacelo novaeguineae	Laughing Kookaburra		X	X	X	X	X
MAMMALS							
MURIDAE							
Mus musculus	House Mouse			X			X
Rattus rattus	Black Rat						
LEPORIDAE							
Oryctolagus cuniculus	Rabbit				X	X	X
CANIDAE							
Vulpes vulpes	Red Fox				X	X	X
FELIDAE							
Felis catus	Feral Cat				X	X	

APPENDIX 2 List of species recorded in the various sites assessed for vertebrate fauna during September 2005. (CL – Cleared land; OT – Other locations, mainly wetland habitats.)

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		Site Code			
		8/9	**16**	**CL**	**OT**
BIRDS					
ANATIDAE					
Tadorna tadornoides	Australian Shelduck			X	X
Chenonetta jubata	Australian Wood Duck				X
Anas gracilis	Grey Teal				X
Anas superciliosa	Pacific Black Duck				X
PHALACROCORACIDAE					
Phalacrocorax melanoleucos	Little Pied Cormorant				X
ARDEIDAE					
Ardea novaehollandiae	White-faced Heron				X
THRESKIORNITHIDAE					
Threskiornis molucca	Australian White Ibis			X	
Threskiornis spinicollis	Straw-necked Ibis			X	
ACCIPITRIDAE					
Accipiter fasciatus	Brown Goshawk			X	
Aquila audax	Wedge-tailed Eagle			X	
FALCONIDAE					
Falco cenchroides	Australian Kestrel			X	
COLUMBIDAE					
Phaps chalcoptera	Common Bronzewing	X			
PSITTACIDAE					
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo		X		
Calyptorhynchus baudinii	Baudin's Cockatoo		X	X	
Cacatua roseicapilla	Galah	X		X	
Platycercus zonarius	Australian Ringneck	X	X	X	X
Platycercus spurius	Red-capped Parrot	X	X	X	X
Neophema elegans	Elegant Parrot			X	
MALURIDAE					
Malurus splendens	Splendid Fairy-wren		X	X	X
PARDALOTIDAE					
Pardalotus striatus	Striated Pardalote	X	X		
ACANTHIZIDAE					
Gerygone fusca	Western Gerygone	X	X		
Acanthizia inornata	Western Thornbill	X			
Acanthizia chrysorrhoa	Yellow-rumped Thornbill	X			
MELIPHAGIDAE					
Lichmera indistincta	Brown Honeyeater		X		
Anthochaera carunculata	Red Wattlebird	X	X		
PETROICIDAE					
Petroica multicolor	Scarlet Robin		X		
PACHYCEPHALIDAE					
Pachycephala pectoralis	Golden Whistler	X			
Pachycephala rufiventris	Rufous Whistler	X			
DICRURIDAE					
Rhipidura fuliginosa	Grey Fantail	X	X		

		Site Code			
		8/9	**16**	**CL**	**OT**
Rhipidura leucophrys	Willie Wagtail		X		X
CAMPEPHAGIDAE					
Coracina novaehollandiae	Black-faced Cuckoo-shrike		X	X	
ARTAMIDAE					
Artamus cyanopterus	Dusky Woodswallow			X	
CRACTICIDAE					
Cracticus torquatus	Grey Butcherbird	X		X	
Cracticus tibicen	Australian Magpie			X	
CORVIDAE					
Corvus coronoides	Australian Raven		X	X	
HIRUNDINIDAE					
Hirundo nigricans	Tree Martin		X	X	
ZOSTEROPIDAE					
Zosterops lateralis	Grey-breasted White-eye		X		
MOTACILLIDAE					
Anthus australis	Australian Pipit			X	
NATIVE MAMMALS					
PERAMELIDAE					
Isoodon obesulus fusciventer	Southern Brown Bandicoot		X		
MACROPODIDAE					
Macropus fuliginosus	Western Grey Kangaroo	X	X	X	X
PHALANGERIDAE					
Trichosurus vulpecula vulpecula	Common Brushtail Possum	X	X		
AMPHIBIANS					
HYLIDAE					
Litoria adelaidensis	Slender Tree Frog				X
MYOBATRACHIDAE					
Limnodynastes dorsalis	Banjo Frog				X
Crinia georgiana	Quacking Frog				X
Crinia glauerti	Glauert's Froglet				X
Crinia insignifera	Squelching Frog				X
Geocrinia leai	Lea's Frog				X
INTRODUCED SPECIES					
BIRDS					
HALCYONIDAE					
Dacelo novaeguineae	Laughing Kookaburra	X	X	X	
MAMMALS					
LEPORIDAE					
Oryctolagus cuniculus	Rabbit		X	X	
CANIDAE					
Vulpes vulpes	Red Fox		X		
FELIDAE					
Felis catus	Feral Cat		X		